Abstracts.

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General.

1. Text of New Petroleum Bill. *Oil News*, **18**, 682, pp. 639—642. 1925.

The text of the Petroleum Bill, which has now (Dec. 26, 1925) reached the post-report stage in the House of Lords, is given.

Section 3 of the Act of 1871 ceases to have effect and that act has effect as if "petroleum spirit" were substituted for "petroleum to which this Act applies." Under the new bill, "Petroleum" includes crude petroleum, oil made from petroleum, or from coal, shale, peat or other bituminous substances, and other products of petroleum; and "Petroleum spirit" means such petroleum as gives off inflammable vapour at less than 73°F. when tested in accordance with the Act of 1879.

By-laws as to ships carrying petroleum are to include by-laws as to loading of ships with petroleum spirit and precautions as to such ships when in harbour.

Persons who act in contravention to Section 6 of the Act of 1871 are liable to a fine of £5 and the occupier of premises in which spirit is kept in contravention of Section 7 of the same Act is liable to a fine of £20 per day, and in each case a court has the power to order the confiscation of the spirit.

A licensee under the Act of 1871 who contravenes the conditions of the licence is liable to a fine of £20 per day. Conditions to be observed by workmen are to be posted in a prominent position and the occupier of premises failing to do this, any person injuring or defacing such notice, or any workman acting in contravention of such notice, are liable to a fine of £5.

The provisions of the Explosive Act, 1875, with modifications for petroleum spirit, are incorporated in the new Act.

License fees are on a graduated scale from 5s. 0d. up to 600 gallons to £5 for over 600,000 gallons of petroleum spirit. G. S.

2. Action of Aluminium Chloride on Hexahydroaromatic and Saturated Aliphatic Hydrocarbons. R. K. Stratford. *Les Matières Grasses*, 1925, 7321—7323. (Part II, to be continued).

The action of aluminium chloride at 150—160°C. on n-butylcyclohexane, at 140—150°C. on *sec*-butylcyclohexane, or at 150—160°C. on *tert.*-butylcyclohexane leads to the elimination of *n*-butane, together with a mixture of the isomerides of tetramethylcyclohexane. *n*-Butane is also formed by the action of aluminium chloride on *n*-amylcyclohexane at 130—155°C., together with liquid products, of which the highest boiling fraction, 170—200°C., is unsaturated, whilst the intermediate fraction has b.p. 160—170°C, $n^{15}D$ 1·4432, these constants being "the same as those of the product obtained starting from the butylcyclohexanes." W. S. N.

3. Progressive Halogenation of Saturated Acyclic Hydrocarbons. H. Gault. *Les Matières Grasses*, 1925, 7319—7321. (Part II, to be continued).

The author collects data on the chlorination and bromination of methane, and the chlorination of propane and butane. The use of antimonic, ferric, and aluminium chlorides, and of iodine, in halogenation is referred to.
W. S. N.

4. Specific Heats, Heats of Vaporisation, and Critical Temperatures of California Petroleum Oils. E. H. Zeitfuchs. *Ind. Eng. Chem.*, 1926, **18**, 79—82.

The specific heats of California petroleum oils of widely varying specific gravity have been determined by dropping the heated oil sealed in a light steel bomb into a mass of water. Measurements were made up to 371·1°C. The critical temperatures and densities of these oils were determined by observations of the meniscus of the oils heated in sealed, graduated, glass capillary tubes. Curves showing the heat of vaporisation as a function of temperature have been constructed by the aid of Tronton's rule, the slope of the curves being known at the critical temperature and at about 38°C. above the average boiling point at atmospheric pressure. W. S. N.

5. Thermal Expansion of California Petroleum Oils. E. H. Zeitfuchs. *Ind. Eng. Chem.* 1925, **17**, 1280—1283.

Various Californian petroleum products were tested to ascertain their coefficients of thermal expansion over a range of temperature from 25° C. to 400° C. Glass picnometers were employed up to 200° C. and steel picnometers for higher temperatures. These were heated in vapour baths of acetone, benzene, water, aniline and naphthaline and in a bath of melted solder maintained at constant temperature, and the weights of the contents at various temperatures ascertained. A single formula was not found to cover the expansion over the whole range. Tables and graphs of the results are given. The coefficient was found to increase rapidly at the higher temperatures, and to be greater for high temperatures than is the case in oils of other fields. A graph indicates the error introduced by using the National Standard Petroleum Tables for computations with these products. This error is 7% for a product of 50° A.P.I. gravity. H. M.

6. Relationship Between Boiling Points and Some Other Properties of Petroleum Products. By J. B. Hill and S. W. Ferris. *J. Ind. and Eng. Chem.* 17, 12, 1250.

This paper presents a collection of data obtained by determining the physical properties, including vacuum assay distillation, of a large number of distillate fractions obtained from various crude oils. The fractions show interesting relationships between their boiling ranges and their viscosities, specific gravities, and refractive indices. Five typical crudes have been examined, varying from a Pennsylvanian crude to a highly naphthenic Gulf Coast crude. For fractions of the same boiling point, as indicated by the 50% point on the vacuum assay distillation, as the crude varies from paraffinic to naphthenic, the viscosity, the coefficient of viscosity change with temperature, the specific gravity and the refractive index all increase. This relationship is a good indication of the source of the oil. Numerous experimental data are published in the paper. A. W. G.

7. Latent Heats of Vapourisation of Distillates from Paraffin-Base Petroleum. E. H. Leslie, J. C. Geniesse, T. W. Legateki and L. H. Jagrowski. *Ind. Eng. Chem.*, 1926, **18**, 45—46.

Fractions, of narrow boiling range (*ca.* 9° maximum), the boiling points of which varied from 152° C. to 576° C., were taken from a paraffin-base petroleum from Cabin Creek, W. Va. The latent heats of individual fractions were measured by determining the weight of distillate produced by the introduction of a quantity of heat known in terms of electrical measurements, the apparatus consisting essentially of a vacuum flask fitted with a condenser and provided with an internal heating element. Direct heat loss from the apparatus at various temperatures was found by distilling substances of known latent heats (benzene, toluene, dimethylaniline), a curve being constructed from which the heat loss at any given temperature could be read. During the actual experiments the temperature rise was not greater than 0·5° C.; allowance was made for the absorption of sensible heat consequent on this rise, the specific heats of the fractions being known. Boiling points were in all cases calculated to 760 mm. pressure. The results do not lend themselves to abstraction; it is, however, to be noted that, contrary to expectation, the latent heats found were greater than those obtained by Gurwitsch (*Wissenschaftliche Grundlagen der Erdöl Verarbeitung*, Berlin, **1913**, p. 85) for fractions, of corresponding b.p. from a Baku, naphthene-base petroleum. W. S. N.

8. Conditions Governing the Efficiency of Gas Burners. By S. W. Parr. *J. Ind. Eng. Chem.* **17**, 12, p. 1215.

The author traces the development of burners for utilising manufactured gas from the earliest forms, supplied with secondary air only, up to the Méker type. He describes the Bunsen burner as "the limiting illustration in the matter of inefficiency." In explanation he asserts that to maintain a non-luminous flame of any considerable size with a Bunsen burner the ratio of preliminary air to gas is as low as 1 to 4 and that in order to complete combustion it is necessary, in addition, to supply fifteen times as much air as secondary air. Moreover, a very large quantity of "entrained" air acts as a heat diluent owing to the greatly increased flame area. The use of such a low proportion of primary air in a Bunsen burner is probably in order to minimise danger of "striking back."

In the Méker burners the amount of primary air employed is practically that necessary for complete combustion (4 parts of air to 1 part of gas). The liability of a burner of the Méker type to striking back is discussed, and the means adopted and the gas pressure necessary to eliminate this danger are explained. Were gas companies to supply gas at pounds of pressure where inches now obtain the difficulty would be surmounted.

A. W.-G.

9. Chemical Equilibrium in Gases Exhausted by Gasoline Engines. By W. G. Lovell and T. A. Boyd. *J. Ind. Eng. Chem.* **17**, 12, 1216.

The authors have examined, from the theoretical point of view, analyses of exhaust gases of petrol engines obtained by Fieldner and his collaborators and, as described in this very interesting paper, have found the following conclusions:—

"1. Four of the components are in such proportion that the calculated value of the equilibrium constant K of the water-gas reaction

$$CO_2 + H_2 \quad CO + H_2O$$

lies for the most part within narrow limits—namely, 3·0 to 4·0—and that these limits are substantially the same for all conditions of mixture ratio and other variables.

"2. The magnitude of K obtained in this way corresponds to equilibrium conditions that prevail at temperatures of 1350°—1550° C. Investigators who have attempted the actual measurement of the maximum temperatures reached in the combustion reaction in gasoline engines have obtained values of the same order—namely, 1500° to 1800° C.

"3. The composition of the exhaust from gasoline at different fuel-air ratios confirms the hydroxylation theory of combustion of hydrocarbons and further disproves the old belief that the reason for the maxima for the power curves of gasoline engines occurring at about 85% theoretical air lay in a preferential burning of the hydrogen." A. W.-G.

10. Present Status of the Facts and Theories of Detonation. By G. L. Clark and W. C. Thee. *J. Ind. Eng. Chem.* 17, 12, 1219.

The authors give an excellent resumé of the most important work by different investigators up to date into the nature of flame propagation and its incidental phenomena. Detonation is discussed rather fully and the various theories that have been put forward to explain it. The characteristics of a detonation wave are enumerated and the desirable points of design and operation of internal-combustion engines with a view to elimination of detonation trouble are set forth. A better collection of hitherto widely scattered chemical, physical and other facts on the subject would be difficult to find. The authors conclude with a few suggested lines along which future research might proceed. A. W.-G.

11. Effect of Knock Inducers and Suppressors upon Gaseous Ionisation. By G. L. Clark, E. W. Brugmann and W. C. Thee. *J. Ind. Eng. Chem.* 17, 12, 1226.

It has been stated that the presence of one molecule of lead tetraethyl in 200,000 "molecules" of a combustible mixture of kerosene and air suppresses detonation to a marked degree. Wendt and Grimm have put forward a theory to explain the mechanism of this effect, together with experimental evidence in support of it. These experiments have been repeated under carefully controlled conditions, using in place of an alternating current arc as the ionising source, monochromatic molybdenum $K\alpha$ and X-rays of constant intensity, and a gold leaf electroscope and a sensitive quadrant electrometer for measurement of the ionisation currents. The ionisation of air, air plus benzene and air plus various knock suppressors (lead tetraethyl) and inducers (butyl nitrite) have been determined. The presence of butyl nitrite slightly increased the total ionisation, which is in opposition to this mechanism. Moreover, the relative rates of recombination of the ions formed in the benzene-air mixture are anomalous. The theory of electron wave fronts and the absorption of electrons by anti-knock compounds is therefore not supported by the results obtained by the writers.

Eight theories of the anti-knock compounds are discussed and experiments suggested by the present research are outlined. A. W.-G.

12. Gaseous Explosions. By George G. Brown. *J. Ind. Eng. Chem.* 17, 12, 1229.

The author divides gaseous reactions into two classes, namely, homogeneous reactions wholly confined to a single gas phase, and heterogeneous reactions occurring at the interface between two phases. These two main classes are subdivided into several types—continuously homogeneous, progressively homogeneous and hetereo-homogeneous; heterogeneous reactions

may be gas-gas, gas-liquid or gas-solid. The effect of catalysts on explosions is discussed. The different types of explosions are illustrated by definite reactions and the work of past investigators. A. W.-G.

13. Length of Visible Flame and Length of Flame Travel in Combustion of Powdered Coal. By Harry Kreisinger. *J. Ind. Eng. Chem.* **17**, 12, 1232.

The length of visible flame depends on the percentage of volatile matter in the coal, the composition of the volatile matter, the amount of air supplied with the coal and the rapidity of mixing of the coal with the air. As coals of high volatile matter content burn with long flames, it would appear more difficult to secure their complete combustion, whereas in point of fact it is found that the coals poorer in volatile matter show a higher free-carbon content in their flue dusts. Hence, according to the author, length of flame travel is not necessarily a good indication of completeness of combustion and for the same reason analysis of the flue gases is not a sure test in this respect, giving, as it does, only an indication of the amount of air used in combustion. Only a portion of the air necessary for combustion should be admitted before combustion: efficient mixing of the majority of the air during combustion being essential for maximum combustion of fuel fed to the furnace. A. W.-G.

14. The Mechanism of Combustion in a Bunsen Cone. By E. W. Rembert and R. T. Haslam. *J. Ind. Eng. Chem.* **17**, 12, 1233.

The authors have studied the effect of wall temperature, port velocity, port diameter and air-gas ratio upon the rate of combustion and height of cone. Variation of wall temperature between 110° C. and 1100° C. had no appreciable effect upon the rate of combustion of the gas (town's gas), and combustion was found to be complete a short distance above the port with only 5% excess air. The rate of change of cone area decreased with increasing port velocity, becoming practically constant at high velocities. The rate of change of cone height decreased with port diameter, and the rate of combustion in the cone increases with increase in the primary air-gas ratio. The results indicate that the transfer of heat from the flame surface to the cold gas is the factor controlling the combustion of gas with primary air. A. W.-G.

15. Factors Influencing the Length of Flame Burning in Secondary Air. E. W. Rembert and R. T. Haslam. *J. Ind. Eng. Chem.* **17**, 12, 1236.

As a result of experiments on the effect of port velocity, port diameter and the primary air-gas ratio the authors found that the total length of flame, F, is given by the equation:—

$$F = K.\ \log.\ u + B.\ \log.\ D. + E.$$

where "u" is the port velocity, D is the port diameter and K, B and E depend upon the primary air-gas ratio. The authors show how this equation may be applied to problems of furnace design. A. W.-G.

16. Factors Affecting Utility of Secondary Air in Gaseous Combustion. E. W. Rembert and R. T. Haslam. *J. Ind. Eng. Chem.* **17**, 12, 1238.

It is found that the total amount of secondary air supplied and the rate of its admixture with the burning gases materially affects the quantity which is actually utilised in combustion. Practical applications of the results are discussed and it is shown that by plotting the logarithm of the air supplied against the amount which is utilised, approximately a straight line is obtained, thus making it possible to determine the necessary excess air for efficient combustion with any quantity of gas once two points have been determined.

A. W.-G.

17. Relative Rates of Combustion of Constituents of City Gas Burning in Secondary Air. E. W. Rembert and R. T. Haslam. *J. Ind. Eng. Chem.* **17**, 12, 1240.

Consideration of the results which these investigators have obtained in the course of their researches leads them to the conclusion that the rates of relative combustion of the combustion of the components of city gas [an average analysis of which is (in per cent. by volume) CO_2:3·1%; O_2:0·8%; CO:16·1; H_2:42·0; CH_4:24·9; Illuminants: 4·6.] burning in secondary air, can be expressed in terms of general mass action expressions for velocities of reaction, provided that 80% of the gas has been burned. Port velocity and diameter have little effect upon the change of relative percentages of the constituents.

In the reactions

$$C_2H_4+O_2=2CO+2H_2$$

and

$$CH_4+O_2=CO+H_2+H_2O,$$

which the authors suppose to take place during combustion, $\frac{K.C_2H_4}{K.CH_4}=1·1$.

Carbon monoxide and hydrogen burning simultaneously in the presence of small quantities of ethylene and methane behave according to the expression

$$1/H_2=\frac{KH_2}{KCO}(1/CO)+C.$$

the slope of the curve being approximately

$$\frac{K.H_2}{K.CO.}=4·9.$$

Similarly for hydrogen and methane; the slope being $\frac{K.CH_4}{K.H_2}=3·0$, and for monoxide $\frac{K.CH_4}{K.CO.}=14·5$.

A. W.-G.

18. The Heat of Absorption of Gases by Coal and Charcoal. A. G. R. Whitehouse. *J. Soc. Chem. Ind.* **45**, 3, 13. T.

The object of the investigation described in this paper was to add to the present information of practical value in such mining problems, as gas outbursts and spontaneous combustion. A résumé of past work on the subject is given. The apparatus employed by the author consisted of an adsorption apparatus for measuring the amount of gas adsorbed and a modified Bunsen ice calorimeter for measuring the thermal change. Four coals—a South Wales anthracite, a South Wales (No. 2 Rhondda seam) coal, a Scottish coal and a Kersely coal—and an activated coal charcoal were the adsorbents used. Unfortunately, the temperature at which the "coal charcoal" was prepared is not stated. The constants of the apparatus and the necessary corrections were carefully determined.

The heat of adsorption of carbon dioxide, sulphur dioxide, methane, oxygen, nitrogen and carbon-monoxide by the coals and charcoal were determined at 0° C. The heat evolved per c.c., of gas adsorbed was found to decrease as

more gas was adsorbed, the values being for CO_2, 0·346—0·255 cal.; SO_2, 0·627—0·354 cal.; CH_4, 0·245—0·199 cal.; O_2, 0·19—0·17 cal.; N_2, 0·22—0·17 cal., and for CO, 0·198—0·188 cal. The results obtained with oxygen suggest that a certain amount of oxidation takes place even at 0° C. A simple exponential equation ($h = mx^n$ where h = total heat in cals. evolved per grm. adsorbent, and x = total number of c.c. of gas adsorbed measured at N.T.P. per grm. of adsorbent) was found to hold over the range covered by the experiments. The gases studied were adsorbed more slowly by the coals than by charcoal, the difference being most marked in the cases of methane and nitrogen. The author ascribes this to difference in textures of the adsorbents.

A. W.-G.

19. American Consumption of Natural Gas. *Pet. Times.* Dec. 26, 1925. p. 1086.

The consumption of natural gas in the United States in 1924 amounted to the record figure of 1,141,482,600,000 cubic feet and the actual production to 1,141,521,000,000, the difference being equal to the quantity of gas consumed in Canada and Mexico, but produced in the United States. The estimated value of the gas at the wells was $105,779,000 and at the points of consumption, $253,830,000. The ratio of natural gas consumed for domestic purposes to total consumption decreased, but the actual domestic consumption in 1924 increased 6%. The average value of gas consumed for domestic (household) purposes ranged from 29·6 cents per 1,000 cub. ft. in West Virginia to 91·2 cents in Missouri, and for natural gas employed for industrial purposes, from 2·6 cents in Colorado to 53·2 cents in Maryland. Eighty-nine per cent. of the total consumption of natural gas in the United States was reported as treated for extraction of natural gas, gasoline and 14% of the total amount consumed was used in the production of carbon black—the quantity of carbon black produced, however, is not given.

A. W. G.

20. Evaporation Losses of Gasoline in the Refinery. By Ludwig Schmidt. *U. S. Bureau of Mines. Petroleum Times*, xv. 365, 41—44, 366, 89—90; 368, 171—173.

The evaporation of gasoline at a number of refineries in the American and Mid-Continent field has been determined and the results have been collected together in this paper. The losses have been determined at different stages of refining, namely, (1) run-down tanks; (2) treating (agitations); (3) filling tank-cars; (4) storage of refined products; and (5) miscellaneous handling. The results obtained with different types of tanks and washing are given; the effect of paint, colour, water covering and vapour open above stored spirit is also shown. The average results obtained are as follows:—

Stage of handling.	per cent. loss.
Run-down tanks	1·8
Treating	0·5
Filling tank-cars	0·5
Storage	2·5
Miscellaneous handling	1·0
Total	6·3

The figure for miscellaneous handling is based on the assumption that the gasoline is handled at least three times after leaving the run-down tanks. The storage loss is based upon the assumption that on the average gasoline is held three months before shipping. Ten thousand and 25,000 barrels storage tanks showed average losses of 6·44 and 6·28 barrels per day.

A. W.-G.

21. Recovery of Gasoline, Etc. H. B. Bernard, Assr. to Sinclair Oil and Gas Co. *U.S.P.* 1,560,137 of 3rd Nov., 1925, Appl. 8th May, 1924.

Absorbed gasoline is separated from liquid absorbing media by subjecting them to distillation. The heated liquid residuum from distillation is passed in counter-current and in indirect contact with the distilled vapours under a lower pressure than that of the distillation treatment. H. M.

22. Gasoline Recovery. H. B. Bernard, Assr. to Sinclair Oil and Gas Co. *U.S.P.* 1,560,138 of 3rd Nov., 1925. Appl. 27th May, 1924.

Natural gas, casinghead gas, etc. are subjected to treatment with a liquid, absorbing medium, which is then preliminary distilled, and the hot distillate passed in counter-current and indirect contact with the vapours from the distillation treatment. H. M.

23. Steam Generation in 1925. David Brownlie. *J. Soc. Chem. Ind.* **45**, 2, 21—22. 1926.

An outstanding feature of 1925 is the increase in the use of scientific methods in boiler houses, the use of instruments such as automatic coal weighers, meters for fuel oil, boiler feed-water, etc., being regarded as essential. Another feature is the fact that continuous running efficiencies of 90% all the year round are now almost certain. Several new types of steam generator are mentioned and a brief description of the McEwan-Runge low-temperature carbonisation process is given. On March 31st, 1925, 584 generating stations were in operation in Great Britain, the average coal consumption being 2·53 lb. per kw.-hr. The article concludes with brief particulars of work on generating stations during the year. G. S.

24. Natural Water Corrosion and H-Ion Concentration. J. R. Baylis. *Chem. Met. Eng.*, 1925, **32**, 874—875.

The Baltimore Water Department have conducted experiments to elucidate the reason for the corrosion of iron pipes. The electro-chemical theory of corrosion has been confirmed. In no case was a concentration of 3 p.p.m. of soluble iron found in a solution free from oxygen when iron was present when the pH was between 8 and 9. Soluble iron in water containing an excess of dissolved oxygen oxidises at a much faster rate at a pH of 9·0 than at 6·0. If an alkalinity of 50 p.p.m. be assumed, then at a pH of 8·0 less than 0·1 p.p.m. of soluble iron is found in the absence of oxygen, about 0·1 at pH 8·0, about 1·0 at pH 7·5, and about 4·0 at pH 7·0. Below 7·0 pH the soluble iron increases rapidly. Tuberculous deposits tend to form an impervious coating where the soluble iron from the interior comes into contact with dissolved oxygen. If the water has a pH value of about 8·5 the iron forms in a few months an impervious coating of crystalline iron oxide. Pits of $\frac{1}{4}$ in. to $\frac{1}{2}$ in. in depth are often found under tubercles. In these negative ions such as sulphates and chlorides are concentrated, and the overlying tuberculations often contain over 1% of iron sulphates and chlorides. The solubilitiy of ferrous carbonate determines the likelihood of the water to stain. H. M.

25. Some Small Steam Economies that can make Important Saving. Paul Truesdell. *Nat. Petr. News*, **17**, 46, 59—60, 1925.

The most ready and cheapest method of steam economy in the refinery is by reducing consumption. The points for saving of steam, in their order of importance, are, (1) Pumps, (2) Process Work, and (3) Heating of Heavy Oils for Transport. Electrically operated pumps, the current being obtained from generators driven by oil or gas engines, operate at a lower cost than

equivalent boiler capacity. Where electrical power is not available, pump efficiency plays a large part in steam economy, and lubrication is of importance here. With stills, manometers are necessary to control the amount of steam necessary for good results and to keep steam generation down to this quantity. In heating oil for transport purposes a small steam coil in the vicinity of the outlet from the tank is all that is necessary in place of a large steam coil. G. S.

26. Report on Heavy-Oil Engine Working Costs (1924–25). *Submitted to Diesel Engine Users' Association.* 20th Nov., 1925.

For this year's report, particulars from 36 home stations are available, as well as 8 sets of returns from stations abroad and a report by the Alexandria Water Company. In 44 undertakings there is an increase of 25% in installed capacity, and of 19 new engines put down, 4 were of 750 h.p. and 4 of 1,000 h.p. The reliability and economical working of sizes up to 8,000 h.p. has been definitely established. The total output is 51,000,000 units, being 24,000,000 more than for last year, and the average time service is 2,426 hours during the year. The maximum load carried is 74% of capacity for home and 62% for overseas stations, and the average plant load factor 15·3 for home, and 20·9 for overseas. Taking the gross calorific value of the fuel at 19,500 B.Th.U., the over-all thermal efficiency of 44 stations is 24%, or 1% more than for 1923–24. The average fuel consumption per unit was ·731lb., the best results obtained being about ·629 lb. The average consumption of lubricating oil was ·0017 gall. per unit. The average engine cost per unit has fallen from 0·899d. for last year to 0·806d. for home stations. The use of furnace oil has been found satisfactory in cases where centrifugal separation has been adopted. The average maintenance cost is lower, at ·144 per unit, or £·767 per kilowatt installed. In the working of the Alexandria pumping station the cost of maintenance of the Diesel plant was 13% of total running cost, against 9% for last year. The over-all cost per million foot-tons with the steam plant was £6 12s. and with the Diesel plant £2 19s. 11¾d. Costs have generally increased, owing to increase in wages. H. M.

27. Improvements in Analytical Crucibles. J. D. Main Smith. *J. Soc. Chem. Ind.*, 1925, **44**, 539 T.

A useful crucible is described, the main feature of which is that the lid fits internally. The vertical edge of the lid is serrated and fits into the crucible 1 cm. below the top of edge of the crucible. The advantages of this arrangement are the freedom from loss by spurting and creeping and the ability of adding reagents to the contents without removing the lid. It is thus possible rapidly to ignite wet precipitates and to convert to sulphate in many cases. S. B.

28. Analysis of Gases from Technical Hydrogenation Processes. H. I. Waterman and J. N. J. Perquin. *Erdöl und Teer*, 1925, **38**, 11—13 and **39**, 11—13.

A description is given with practical working details of the method of analysis of a gaseous mixture containing a large proportion of hydrogen, together with oxygen, carbon dioxide, carbon monoxide, nitrogen, and hydrocarbons of the acetylene, ethylene, benzene, and methane series. Carbon dioxide is first removed by means of caustic potash. Acetylene is absorbed in an alkaline solution of mercuric cyanide. Ethylene is taken out by a solution containing nitric acid and mercuric nitrate, saturated with sodium nitrate. Benzene is then absorbed in bromine. Oxygen is

removed by alkaline pyrogallol, and carbon monoxide by ammoniacal cuprous chloride solution. Advantage is now taken of the fact that at 240°—270° C. hydrogen, but not methane or its homologues, is oxidised by contact with copper oxide; for the combustion of the paraffins a red heat (800°—900° C.) is necessary. The copper oxide is advantageously contained in a nickel combination chamber, cooled at the ends; the cold space is filled with glass capillaries. The loss in volume of the gas after passage over the copper oxide at 240°—270° (the operation being repeated to constant volume, is a direct measure of the hydrogen present. To the small residue of gas a known volume of nitrogen is now added (the nitrogen is stored in contact with alkaline pyrogallol solution); on treatment of the mixture with caustic potash there should not be any absorption, showing that at 270° C. oxidation of the paraffins has not occurred. The copper oxide is now heated to a red heat and the gas passed over it ten times; since cold copper oxide retains carbon dioxide in combination, the last traces of gas are now washed out by means of oxygen (about 20 c.c., the exact volume being determined later) whilst the combustion tube is still hot. After measuring the gas, the carbon dioxide is absorbed by a double treatment with caustic potash and the gas again measured. The oxygen content (deliberately added, *vide supra*) is now measured by absorption in alkaline pyrogallol. In actual practice this operation is performed in two stages, a known volume of nitrogen being added in the process; this is necessary since oxygen is present not only in the measuring burette but also in the combustion tube. After the pyrogallol treatment the residual gas contains added nitrogen (of known volume) and the original nitrogen present in the mixture. After allowing for the known volume of oxygen added there is an increase in volume after treatment with copper oxide at a red heat. Were methane alone present this would not be so: $CH_4+[2O_2]=CO_2+[2H_2O]$, but an increase in volume accompanies the combustion of the higher paraffins, *e.g.*, $2C_2H_6+[7O_2]=4CO_2+[6H_2O]$. If the volume of carbondi oxide formed is x and the increase of volume on combustion (after allowing for added oxygen) is y, then we have $n=x/(x-y)$, where n is the mean number of carbon atoms per molecule of hydrocarbon oxidised. The difference between the volume of gas subsequent to combustion at 240°—270° C., and the residue of nitrogen (after allowing for added nitrogen) gives the volume of paraffin hydrocarbons originally present. W. S. N.

Refining and Distillation.

29. Laboratory Distillation Analysis of Petroleum. H. G. Vesper. *Ind. Eng. Chem.*, 1926, **18**, 64—67.

This article gives a description of the "four-point" method of gasoline determination of the Standard Oil Company of California, with certain modifications; kerosene and lubricating oil stock determinations are likewise described.

The crude oil is topped to a vapour temperature of 500° F. in a 4000 c.c. copper vessel, the distillate being collected at not more than 10 c.c. per minute. If necessary, a crude containing much water is first heated in a closed vessel to a pressure of 100 lbs. per sq. in., and distillation effected by a gradual release of pressure. The naphtha is now redistilled from a 500 c.c. flask with a 6 in. jack chain tower. The object is to estimate the yield of gasoline conforming to the following Navy specifications: 20% volatile at 221° F., 50% at 284° F., 90% at 392° F., and 100% at 437° F. Hence, in the four-point method of analysis, the volumes of distillate at each of these four control temperatures are noted and divided by, respectively, 0·20, 0·50, 0·90, and 1·0,

i.e., from each volume noted the yield of gasoline conforming to the specification is estimated. The distillation is then continued to the lowest of these calculated yields and the distillate tested for Navy specifications gasoline by the A.S.T.M. method. This procedure is based on the assumption that the distillation curve of the naphtha and the A.S.T.M. distillation curve of the gasoline are identical. Distillation results are presented graphically, for different Southern California crude oils, which show that the curves are, however, only coincident at the 50% and 90% points, there being considerable divergence at the start and end of the distillations. The following empirical procedure has been found to give the yield of Navy specifications gasoline, with an error of not more than 3° F. at the 20% point in the A.S.T.M. distillation. The control temperature are 200° F., 221° F., 284° F., 392° F., and 420° F.; the per cent. distillate at these points are noted. If the per cent. distillate at 200° F. is 5 or less, the distillate at 221° F. is multiplied by 5; if there is 5·5—6·0% at 200°, the distillate at 221° is multiplied by 4·5; if 6·5% or more distils at 200°, the per cent. at 221° is multiplied by 4. The per cent. distillates at 284°, 392°, and 420° are divided by 0·50, 0·90, and 1·0 respectively. The distillation is cut to the lowest of these yields and the fraction tested by the A.S.T.M. method for Navy specifications gasoline. To obtain the yield of blending gasoline, the per cent. distillate at 392° F. is divided by 0·90 and the distillate cut at the calculated volume and tested by the A.S.T.M. method. After the removal of the required grade of gasoline, the distillation is run to a temperature 10° F. below the required final boiling point of a lamp oil, in order to estimate the yield of the latter. For lubricating oil stock, the residue from the topping of the crude oil is redistilled at 4 mm. pressure, the distillate collected in 4 % cuts (starting at 450° F.) and the latter blended to any desired viscosity, 500 seconds (Saybolt) at 100° F. being taken as indicative of a medium heavy stock. Figures are quoted showing the Navy specification gasoline and lamp oil contents, by the above methods, of ten Southern California crude oils. W. S. N.

30. The Vacuum Assay Distillation Test. By A. G. Peterkin, Jr. and S. W. Ferris. *J. Ind. and Eng. Chem.*, **17**, 12, 1248.

The assay distillation test under vacuum described in the Bureau of Mines Bulletin 207 has been modified so as to be suitable for routine work in a refinery laboratory. A novel pressure adjusting attachment is employed. A. W.-G.

31. High-Precision Fractional Distillation in the Laboratory W. A. Peters, Jr. and T. Baker. *Ind. Eng. Chem.*, 1926, **18**, 69—72.

The article comprises a description of two forms of an apparatus for fractionally distilling mixed liquids. Both forms have, in common, a controllable dephlegmator, by means of which a definite proportion of the vapour reaching the head of the column is condensed; this artificial supply of reflux to the column gives greatly increased sharpness of separation, particularly at the point when the last of a certain component is being taken off.

The first apparatus is for use with low-boiling liquids, *e.g.*, mixtures of water and the common alcohols. The round-bottomed flask is of 500 c.c. to 1000 c.c. capacity. The glass column, 1·5 metres long and 12·5 mm. internal diameter, is not constricted at the lower end; a wire, fused diametrically through the base, supports a coarse wire plug, on which rests the filling. The latter is composed of 5 mm. lengths of glass tubing, 5 mm. external diameter. The lower part of the column, for a length of 1·08 m., is jacketed for protection against draughts. The dephlegmator takes the form of a water-cooled jacket, 20 m. long, the upper end of which is about 4 cm. below the side arm. The flow of water through this jacket, and the level in the jacket, are both pre-

cisely controlled. It was found that with a column 12·8 mm. diameter, with 1·22 m. of 5 mm. × 5 mm. filling, the hold-up of liquid was about 15 c.c. In operation it is advisable to start with total reflux and to so regulate the rate of boiling that the column just fails to choke or load up; the dephlegmator is then allowed to warm up until the required velocity of distillation is attained, *i.e.*, *ca.* 0·5—2·5 c.c. per min. With petroleum the reflux would be approximately 15 c.c. per min. and the distillate 1 c.c. per min., giving a reflux ratio of 15 : 1.

The second, more elaborate, apparatus is designed for use with liquids boiling above 100° C., especially petroleum. The flask, round-bottomed and of 500 c.c. capacity has three openings—for the column, for a thermometer, and for an internal heating element (an electric hot-plate may alternatively be used). The column is *ca.* 120 cm. long, 12·8 mm. internal diameter; a short length at the top is wider—about 31·5 mm. internal diameter. The column is double jacketed, provision being made for heating by means of (1) a regulated current of warm air of known temperature; (2) an internal heating element, consisting of four lengths of resistance wire, joined in series, introduced vertically through the annular space of the jacket. Control of the jacket-temperature is facilitated by the insertion of a thermometer in the top, side by side with the dephlegmator. The latter, 30·2 cm. long and 14 mm. diameter, has a side arm 118 mm. from the top, and is corked or stoppered into the wide top of the column. The dephlegmator is water-jacketed from the bottom to within 140 mm. of the top; provision is made for accurately adjusting the level and flow of water. The Liebig condenser which slopes at an angle of *ca.* 45° to the vertical, is water enjacketed for a length of 25 cm.; the end is bent vertical and passes through the stopper of a graduated cylinder. The latter has a side arm, a short distance from the top, which is connected with a graduated tube inserted vertically in a Dewar vessel containing liquid air.

In practice, the temperature of the column-jacket is adjusted to within a few degrees of the temperature of the uncondensed vapours. It is therefore sometimes advantageous to use the vapour of a suitable organic liquid as heating medium for this jacket, which may readily be modified for the purpose.

Striking results are quoted showing the separation of mixtures of water, acetone and ethyl and *n*-butyl alcohols; moreover pure specimens of *o*-and *p*-ethyl nitrobenzene were obtained from the binary mixture, in one distillation, a result hitherto only accomplished by performing 80 or 100 redistillations. W. S. N.

32. Improvements in Refining Petroleum. *Pet. Times*, Dec. 26, 1925: p. 1084.

As a result of work on the addition of colloidal earths and salts to some crude oil samples, two chemists of the Western Minerals Company, Denver, were led to investigate the action of certain "reagents" on various oils. Two reagents are introduced into the crude oil at a temperature of 75°F., the whole is mixed machanically and allowed to stand for several hours. Chemical combination of the reagent with the oil is supposed to take place, the amount of reagent used and the time of standing being determined by laboratory tests and the nature of the oil. Free carbon and unsaturated bodies are deposited as a sludge, sulphur is eliminated by the reagent and an increase in the gasoline content of from 30 to 50% is obtained in the subsequent distillation. The distillation occurs wholly below 570°F. and the action of the reagent is stated to make cracking possible at the low temperatures of open distillation. The cost of this "Colorado reagent" is given as 12 cents. per barrel on light grades of oil, and as 12 to 25 cents. on heavier oils. The nature of this "reagent" is, however, not divulged. A. W.-G.

33. Revivifying Fuller's Earth. F. W. Hall, Assr. to the Texas Co. U.S.P. 1,562,550 of 24th Nov., 1925 (Appl. 28th July, 1923).

Spent absorbent material used in refining mineral oils is subjected to the distilling action of a carrier gas and then heated in the presence of air. H. M.

34. Method of Treating (Decolourising) Oil. P. W. Prutzman and C. J. von Bibra, Assrs. to General Petroleum Corporation. U.S.P. 1,562,001 of 17th Nov., 1925 (Appl. 2nd Sept. 1922).

A mass of pulverulent solid decolourising material is prepared in the form of an aqueous mud, air being thus excluded from the pores of the decolourant. Such mud is mixed with the oil, and the mixture heated to drive off water, the solid decolourising material being thus brought into intimate contact with the oil. The spent decolourant is separated from the oil. H. M.

35. Process for Removing Acids from Oils. P. W. Prutzman and P. D. Barton. Assrs. to General Petroleum Corporation. U.S.P. 1,562,000 of 17th Nov., 1925 (Appl. 2nd Sept., 1922).

Acid tar is removed from acid-treated petroleum oil by agitating the oil with a powdered absorbent which has expended its adsorptive value in removing impurities from tar-free oils, and is charged with tar-free oil. H. M.

36. Method of Treating Oils. P. W. Prutzman, Assr. to General Petroleum Corporation. U.S.P. 1,561,999, 17.11.22. Appl., 2.9.22.

In order to purify and partly decolourise oil, a portion of it is mixed with a powdered adsorbent material, and the mixture allowed to rest till the oil has displaced the air from the pores of the adsorbent. The remainder of the oil is heated to over 350°F., and added to the mixture, to permit the adsorbent to withdraw colouring matter from the oil. The spent adsorbent is mechanically separated from the decolourised oil. H. M.

37. Process for Series Separation of Crude Petroleum. A. R. Earl and T. W. Reeves. U.S.P. 1,567,429, 29.12.23. Appl., 25.8.23.

Mineral oil is continuously distilled by heating under pressure by means of steam, releasing the pressure of the oil and passing it into an expansion zone where it partially vaporises. The vapours are fractionally condensed: the unvaporised oil is withdrawn and further heated, without permitting its vaporisation, and it is passed into an expansion zone at a pressure below atmospheric, where the lighter products vaporise. The vapours are condensed and the unvaporised oil withdrawn and heated by direct contact with superheated steam under sufficient pressure to prevent the vaporisation of the oil. The heated oil is passed into an expansion zone at a pressure below atmospheric and partially vaporises. The vapours are condensed and the unvaporised oil withdrawn. H. M.

38. Method of Distilling Oil. L. E. Hirt. U.S.P. 1,559,701. 3.11.25. Appl., 2.3.20.

The oil flows in thin films through a series of tubes in which the distillation takes place, and a gaseous medium other than the hydrocarbon being distilled is pressed through the tubes to remove mechanically the vaporised contituents of the oil. H. M.

39. Hydrocarbon Distillation. H. G. W. Kittridge, Assr. to C. A. Kittridge. U.S.P. 1,561,169. 10.11.25. Appl., 13.8.19.

The still consists of a first reservoir with an arched top which is exposed to the heat from the furnace. The lower portion of the reservoir intended to receive precipitate is insulated from direct heating by means of brickwork. After passing over the first reservoir the furnace gases pass by means of a fire tube through a second reservoir surmounted by a column and attached condenser. The liquid level maintained in the second reservoir is such that the fire tube is completely immersed. Oil is passed through the first reservoir to the second. T. A. S.

40. Apparatus for Distillation. W. M. Fraser. U.S.P. 1,561,428. 10.11.25. Appl., 11.6.23.

A still is provided with means for agitation consisting of fluid-motor operated by the pressure of ingoing oil and driving a continuous band, fitted with scraper plates. T. A. S.

41. Still. Max F. de Bajligethy. U.S.P. 1,562,690.

A reacting drum is mounted in the boiler and one end projects outside the boiler and terminates in a nozzle which re-enters the boiler. The objects of the drum are to provide for the separation of light elements from heavier ones; to collect sediments, etc., to prevent their being deposited in the boiler; to relieve the boiler of excessive pressure; and to allow of a constant current of fluid passing along the bottom of the boiler and so keep it clear of sediment. G. S.

42. Process of Distillation. D. Pyzel. U.S.P. 1,562,723, 1925.

Liquid or semi-liquid bituminous materials, *e.g.*, asphalt, asphaltic residuums or heavy petroleum oils are mixed with a binder, *e.g.*, sand, sawdust, powdered coke, powdered coal, oil sand, etc., to a desired consistency and rolled in the form of balls through a rotary kiln heated by non-oxidising gases.

The products are gas, fuel oils and coke: or the latter may be spent shale of no commercial value. H. G. S.

43. Improved Apparatus for the Continuous Distillation of Tar or Hydrocarbon Oils. J. Pieters. E.P. 229,306. Conv. (France), 12.2.24.

The apparatus consists of a certain number of horizontal plates arranged one above the other in column form in which liquid for distillation circulates downwards in thin layers. The temperature is gradually increased by heating effected by a central flue formed in the column by annular segments constituting horizontal plates, combustion taking place at the base of the column. Gases for heating do not at any point come into contact with liquid to be distilled. E. J. H.

44. A Method and Means for Stimulating Distillation. J. J. Deschamps. E.P. 234,840. Conv. (France), 30.5.24.

The patent describes means of setting up pulsation in the discharge current of products of distillation or sublimation. A tube is inserted in the discharge pipe which is so constructed to form an injector, pulsation being effected by means of a fan drawing, in the case of distillation processes, gas from

a storage receptacle, otherwise auxiliary gas or vapour, such as hydroden or water vapour. Intermittent interruption of supply of gas is made by means of mechanically actuated shutter situated below a chamber capable of absorbing the reactions. E. J. H.

45. Spiral Reflux Condenser. Fay J. Brown. U.S.P. 1,563,718. 1.12.25. Appl., 25.5.23.

A condenser is described, comprising a casing which includes an inner and outer cylindrical shell with a spiral runaway forming a vapour chamber in the intermediate space between the shells. Openings and traps are constructed at different elevations for receiving and taking off distillates as desired. The inner shell contains three-way water sprays at suitable intervals, the outer casing being unlagged for atmospheric cooling. E. J. H.

46. Apparatus for Refining Petroleum. William H. Stilson, Assr. to Stilson Process Corpn. U.S.P. 1,564,984. 8.12.25. Appl., 20.1.20.

This apparatus is intended principally for Mexican and Californian crudes and consists of a pair of spaced "T's" on the vapour line from the still. These connect a branch line to the vapour line and to connections for collecting the condensate as desired. The trapping of carbon particles carried over with such condensate can be effected by the manipulation of valves. E. J. H.

Lubricating Oil and Wax.

47. Paraffin Wax and Its Properties: Methods of Testing Wax and of Analysing Oil-Wax Mixtures. L. D. Wyant and L. G. Marsh. *U.S. Bur. of Mines; Tech. Paper*, 368, 1925, 26 pp.

The paraffin wax referred to is that obtained in the commercial refining of crude petroleum. The method of refining petroleum for the production of lubricating oils and the separation of wax are described. Finished paraffin wax is valued by its melting point and its freedom from oil and other impurities. The "press method" usually employed to determine its oil content is unsatisfactory for testing wax-oil mixtures with more than 10% of oil. The American Soc. for Testing Materials method for determining melting point was found to be very accurate; the petroleum melting point method of the same Society only requires a small sample, and was used in the experiments, and the Dean-Stark method for estimating water content. For separation and estimation of wax, acetone was employed as a solvent, 5 or 10 g. sample of wax being dissolved by heating under a reflux condenser in enough acetone to make 100 c.c. of solution. The solubility of wax fractions in acetone does not vary greatly between 50° and 70° F., and 60° F. was taken as a standard temperature of test. The melting point of the wax affects the solubility in acetone more than does an increase in temperature between 50° and 70° F. The wax recrystalised a second time from acetone is more nearly free from oil than any ordinary commercial wax. The accuracy of the method increases with the percentage of wax in the sample and its melting point. H. M.

48. Methods of Testing Transformer Oils. H. C. Staeger. *Ind. Eng. Chem.* 1925, 17, 1272—1275.

The author reviews the composition and qualities of transformer oils, and the methods proposed by different authorities for their testing. Graphs are given illustrating the oxidation and sludging of oils over prolonged

periods in the presence of various metals. He states that the temperature of the Michie test, 150° C., is too high, and that the test which agrees best with the results in actual service is the BBC test, in which the oil is heated in a copper beaker to 112° C. for 300 hr. and the sludge determined gravimetrically. H. M.

49. Improvements in and Relating to Methods of Purifying Oils. The British Thomson-Houston Co., Ltd., Assignees to C. van Brunt. E.P. 235,861. 31.12.25. Appl. 28.5.25.

A small amount of resinates of heavy metals, preferably manganese resinate, is added to used lubricating oil before clarifying it by a solution of water glass. The resinate is dissolved in benzol, oil or other solvent, a 20% benzol or oil solution being preferred, and about 1/200th of the weight of the oil is added. About 1/10th per cent. of stearic acid may be added to the resinate. Of the water-glass solution of 40° B. one to four ounces is added to one gallon of oil. After thoroughly mixing the mixture is floated on water heated to 80° C. and the impurities subside as sludge. If benzol be used to dissolve the resinate, it is entirely removed along with the volatile ingredients in the subsequent rectification. None of the reagents used remains in the clarified oil. H. M.

50. Process of Producing Viscous Liquids and Products Thereof. L. Lilienfeld. U.S.P. 1,563,203, 1925.

Viscous oils which, in their rectified form, are practically colourless or are slightly yellow with a marked blue fluorescence, are obtained by treating the higher boiling fractions of tar oil, *e.g.*, the solvent naphtha b.p. 145—200° C. with acetylene in the presence of aluminium chloride. The products are essentially composed of aromatic hydrocarbons, are practically free from aliphatic hydrocarbons and possess a high viscosity. They may be used as lubricants for a large number of objects, have a certain therapeutic value and act as photodynamic sensitising agents. H. G. S.

51. Method of Manufacturing Lubricating Oils. James W. Weir, Assr. of one-half to John C. Black. U.S.P. 1,564,501. 8.12.25. Appl., 21.3.22.

A treatment of lubricating oils is described, which eliminates spraying with neutralising agents, such as sodium hydroxide solution, etc., after the usual acid treatment, and subsequent possible filtration. An addition is made, after "sludging," of finely divided unprocessed mineral earth, such as bauxite, colloidal clay, fuller's earth, etc., during mechanical agitation with gradually increasing temperature. By this means the SO_2 formed by acid reaction is distilled off, any remaining sludge being absorbed in the earth used. E. J. H.

52. Filtering Device. J. V. Apablasa. U.S.P. 1,567,990, 29.12.25. Appl., 11.3.25.

To the bottom of a filter container a cover is detachably secured, and supports rigid and perforated top and bottom filter plates, between which other filtering elements are interposed. The alignment of the plates is so maintained that the perforations in the top plate register with those in the bottom plate. The perforations of the top plate contain a filtering sand, a rotating agitator in the container serving to clean the top plate. H. M.

53. Filter for Reclaiming Crank-case Oil and other Mineral Oils and Animal Fats. J. V. Apablasa, Assr. to C. C. Apablasa. U.S.P. 1,567,989, 29.12.25. Appl., 18.10.24.

At the bottom of a container, a thick pad of felt rests on a wire screen supported by a perforated plate resting on a cover. The material may be preheated before entering the container, which contains an adjustable rotary agitator. H. M.

54. Process of Purifying Mineral Oil Products and the Like. F. Schwarz. E.P. 242,317, 9.11.25.

The invention consists of a process for removing the dark coloured substances from mineral oils by treating the latter with soap, and precipitating the soap together with the dark coloured bodies dissolved in it by means of free alkali. Soap, as such, may be added to the oil, or the constituents —fatty acid and alkali—may be added separately. In cases where the oil already contains a slight amount of fatty acid, it is only necessary to add sufficient alkali to saponify it completely. It is claimed that the waste of oil and formation of emulsions due to the use of acid and soda are obviated by this method of refining. W. H. T.

55. An Improved Lubricant for Engine Bearings and like Purposes. R. and E. Birkbeck and G. E. Webster. E.P. 242,520, 12.11.25.

A lubricant is described in this patent, consisting of:—(1) Pure lard—16 parts; (2) mercury—16 parts; (3) prepared suet—1 part; (4) sulphur —40 parts; (5) castor or other lubricating oil—24 parts. It is claimed that the use of this mixture induces easier running of machinery, reduces efficiency losses through heat, and lasts longer than the ordinary type of lubricant. W. H. T.

56. Method of Purifying Hydrocarbons. A. Greenspan. U.S.P. 1,562,425, 17.11.25.

In this invention, a process is described which aims at removing crystalline and amorphous wax from oil such as heavy residuum, after treatment with acid and soda to remove impurities.

The treated oil is slowly chilled to a temperature of between 80° and 90° F., and then diluted with 15 to 20% of its volume of kerosene, the latter being added slowly in order to assist crystallisation.

The wax which crystallises during cooling is removed by a filter press or other mechanical means.

The filtered oil next undergoes a distillation, whereby the amorphous wax and kerosene are distilled off, leaving as a residue an oil free from wax and suitable for use as a high grade cylinder stock. W. H. T.

57. Strainer for Oil Presses. H. Zander. U.S.P. 1,562,134.

The strainer comprises a number of superposed ring-shaped strainers, separated by distance pieces, with a pressure piston at the upper end and a counter pressure piston at the lower end of the column. A column of tubular strainers, composed of enlarged distance pieces between narrow strainers, is arranged above the ring-shaped strainers and the outlets connected by conduits to the inlets of the ring-shaped strainers. By this means, loss from friction is induced to a minimum. G. S.

58. (*a*) Process for Extracting Waxes from Crude Petroleum. U.S.P. 1,559,981, 3.11.25. Appl., 15.9.21. (*b*) Process for Producing Wax-free Products from Crude Petroleum. U.S.P. 1,559,982, 3.11.25. Appl., 11.7.23. Earl Petty, Assr. to De Laval Separator Co.

(*a*) A means of extracting continuously, amorphous and crystalline waxes from paraffin base crude is described. Crude oil is diluted with naphtha to give an oil of 42° Bé. (about 0·80—0·814), transferred to a mechanical agitator to which is supplied continuously, sulphuric acid. This acid treated oil is pumped with a stream of water of about 1/10th of the volume of oil, to a De Laval centrifugal separator. Sludge and acid water are separated from the oil, the freed oil being pumped to another agitator supplied with a constant stream of soda and a little water. From thence it passes to an excelsior pack causing emulsification and then goes to another centrifugal separator to free the neutralised oil from water, etc. It is then pumped to a mechanical mixer to which is supplied continuously a small proportion of fullers' earth giving intimate admixture. From the mixer the oil goes to a vacuum filter for the removal of earth and colouring matter, thence to a De Laval clarifier to complete the removal of filtering medium. The oil is then reduced to a temperature of about 20° F. for further centrifuging in order to throw out the wax. The wax is now treated in the same manner as the original crude; it is steamed to recover the naphtha, fractionated to produce crystalline wax distillate, the residue being treated as desired. It is claimed that the wax distillate so obtained is richer in wax than that obtained in the usual manner.

(*b*) This patent is very similar to the one above, but covers the treatment of the resulting distillate and residue oils. E. J. H.

59. Improved Wax Sweating and Crystallising Apparatus. The Burmah Oil Company, H. L. Allan, and J. Moore. E.P. 243,447, 29.8.24. Addn. to E.P. 208,195, 15.8.22. B., 1924, 165.

The apparatus consists of a number of superposed wax cells or compartments separated from one another by heating and cooling cells. In the present invention the construction is improved and simplified. The charging and discharging pipes are located in a space between the sides of the trays and the container; separate inter-cell charging and discharging pipes are dispensed with and the heating and cooling effect of the cooling cells through the wax compartments is increased by fitting metal fins which conduct heat to the cooling cell from the wax beneath. T. A. S.

Cracking.

60. "The 'Ormont' Process of Vapour Phase Cracking." *Petr. Times*, Jan. 9, 1926, p. 81 (article by the inventor reproduced from the current issue of *Oil and Gas J.*).

Oil—apparently any oil—is vaporised in the presence of a calculated amount of water at temperatures below 450—500° F. and the vapours so produced are submitted to cracking at temperatures in the region of 800° to 950° F. and under pressures generally below 30 lb. Lubricants may be removed from the vapours before the cracking stage by first passing through suitable condensers and dephlegmators. From the cracking furnaces (which are pipe stills) the vapours are led back to the condensing system where they are fractionally condensed. The only carbon produced is obtained as soot and is deposited in a specially provided place.

Permanent gases (the amount of which is not stated) produced during cracking are stripped, yielding from three to five gallons of gasoline, similar

to casing-head gasoline, per 1000 cub. ft. Analysis of the dry gas gives the following figures: Ethylene and unsaturated hydrocarbons, 20%; hydrogen, 40%; methane, 40%, in approximate values. Sulphur compounds are also present in amount depending on the nature of the cracking stock. The liquid products are of a high state of purity and are free from objectionable smells and gumming bodies. The amount of unsaturated bodies in the cracked spirit rarely exceeds 5%. A. W.-G.

61. Sulphuric Acid Absorptions and Iodine Values of Various Petroleum Products and their Cracked Distillates. Jacques C. Morrell and Gustav Egloff. *J. Ind. Eng. Chem.* 17, 12, 1259.

Past work in sulphuric acid absorption and iodine value determinations is reviewed in an account of determinations of acid absorptions and Hanus' iodine values carried out by the authors on several cracking stocks and their cracked distillates is given. As a result of their work the writers conclude that the sulphuric acid method may only be used as a rapid determination of the relative unsaturatedness of different oils of a particular class, especially light distillates. If the time, temperature and concentration factors are maintained constant, reliable results may be obtained with Hanus' solution. It is suggested that much further study of the mechanism of the reactions involved is necessary, especially the substitution reactions of the higher unsaturated hydrocarbons. A. W.-G.

62. Improvements in or Relating to the Cracking and Separating of Mineral Oils. V. L. Oil Processes, Ltd., and O. D. Lucas. E.P. 244,875, 31.12.24. Appl., 31.10.24.

The oil is preheated to about 400° C. and sprayed into a preliminary heating and cracking retort containing a layer of coke or other carbonaceous material, kept in motion by a conveyor, and there cracked in the form of vapour. Carbon is deposited on the coke and the excess is periodically removed. This first retort is heated to about 500° C., and the vapours pass from it into a second cracking retort or chamber provided with a catalyst and heated to about the same temperature as the first retort. The material to be cracked may be supplied directly from an apparatus for the low-temperature distillation of shale, coal or lignite, connected to the cracking apparatus. The vapours from the second retort pass to a series of condensers, in the first of which the heavier oils are condensed, and in the succeeding ones the medium and light constituents. The medium constituents are returned to the spraying device of the first retort after being preheated, the light products are collected, and the permanent gases led to a gasholder. A portion of the permanent gases may be returned to the preliminary cracking retort to assist in carrying over the vapours, and a small amount of ammonia be added to supply nascent hydrogen on its entry into the retort, assisting in the production of saturated compounds. In the second chamber cracking is effected without substantial deposition of carbon. H. M.

63. Process of Converting Hydrocarbon Oils. J. H. Adams. U.S.P. 1,568,016, 29.12.25. Appl., 5.12.17.

The oil is subjected to direct contact with an electric resistance, which is immersed in the oil and heated to a cracking temperature. The oil under treatment is subjected to a pressure above atmospheric. H. M.

64. Treatment of Hydrocarbons. C. N. Forrest and H. P. Hayden, Assrs. to Barber Asphalt Co. U.S.P. 1,568,018, 29.12.25. Appl., 15.6.20.

Hydrocarbon materials are destructively distilled and gasified by charging with them pieces of inert refractory material as a carrier. The porous charged aggregate progresses through the sphere of reaction, and towards its exit is subjected to a limited counterflow of combustion agent, a region of combustion thus following the region of cracking. The coke from the cracking is eventually consumed, restoring the carrier material to its original clean condition. H. M.

65. Apparatus for Treating Hydrocarbons. F. C. V. Water and F. I. Sunderman, Assr. to Petroleum Laboratories Inc. U.S.P. 1,567,212, 29.12.25. 17.5.23.

The vapours from a still pass into a cracking tube underneath the still, surrounded by a protective element which is spaced from it. The protective element and the still are heated and cool air circulates round the cracking tube and between it and the protective element. H. M.

66. Apparatus for Distilling Oil. G. W. Wallace. U.S.P. 1,561,758, 17.11.25. Appl., 20.5.22.

This apparatus comprises a still for cracking oil, consisting of banks of tubes with transversely disposed headers, arranged in a passage way. The products of combustion circulate longitudinally with regard to the tubes, and endless chains are arranged in the tubes, travelling round sheaves in the headers, to remove carbon from the interior of the tubes. A carbon collection chamber at the bottom side of one header has an outlet through which the collected carbon is discharged. H. M

67. Oil-cracking and Carbon-removing Method and Apparatus. L. D. Wyant. U.S.P. 1,563,818, 1.12.25. Appl., 20.3.22.

The oil is heated to cracking temperature and agitated to maintain the liberated carbon in suspension. Portions of the oil containing charges of carbon are ejected from the heated oil by pressure of the gases evolved from the oil. The charges of carbon are separated from the oil within the still and discharged. An oil-cracking still has a heating and agitating chamber with means for agitating the oil, a collector above the level of the oil, and conductors dipping into the oil for the collection of evolved gases and the conveyance of oil carrying carbon into the collector. Means are provided for separating the carbon from the oil in the collector and discharging it. H. M.

68. Process of Making Motor Spirits and Refining Petroleum Products. B. T. Brooks, Assr. to Carbide and Carbon Chemicals Corp. U.S.P. 1,563,012, 24.11.25. Appl., 1.5.18.

Motor spirit is made by cracking a petroleum product under conditions giving a product rich in olefines. This product is subjected to the action of sulphuric acid of less than 66° B. gravity. The oil is separated from immiscible substances and treated with an alkali, and distilled off. H. M.

69. Improvement in or Relating to Oil Cracking Stills. W. J. Mellersh-Jackson, from Sinclair Refining Co. E.P. 240,355, 1.10.25. Appl., 16.2.25.

In oil cracking stills, to avoid excessive heating of the tubes or shell containing the oil, and at the same time to allow of the maintenance of a high

temperature in the furnace, so as to promote economic combustion of the fuel, pre-heated air is introduced into the furnace, and the high temperature of the furnace gases is modified by the introduction of flue gases before the furnace gases come into contact with the oil tubes or shell. Hot flue gases from near the outlet of the heating chamber are returned and admixed with the products of combustion in the fire box, or between the fire box and the heating chamber. The gases issuing from the heating chamber are utilised to pre-heat a supply of air in a vertical tubular pre-heater, and this air is introduced into the fire box there to promote combustion. The pressure employed in cracking various products may be varied from 90 to 700 lb. per sq. in., and the charging stock may pass once through the tubes or be recirculated in them. The amount of flue gases returned may be regulated by means of a steam jet, and the gases may be so introduced around the walls of the fire box as to protect the arch and other parts of the furnace from the heat of combustion. The oil in the tubes passes in countercurrent to the heating gases. H. M.

70. Process for Cracking Petroleum. G. Egloff, Assr. to Universal Oil Products Co. U.S.P. 1,561,779, 17.11.25. Appl., 19.10.23.

The oil passes through a heating coil, in which it is subjected to cracking conditions of heat and pressure. Thence a portion of the oil passes to a primary expansion chamber, and from this to a secondary chamber. The remainder of the heated oil from the coil is introduced into the liquid oil in the secondary chamber to increase the conversion therein. H. M.

Geological and Fields.

71. New Law Limits Flow of Mexican Wells. *Oil News* **19**, 684, pp. 45—46, 1926.

With the object of conserving petroleum resources of the country, a law controlling the exploitation of wells in Mexico has been made.

Its main provisions are that wells producing 1000 barrels or less per day shall be exploited to their full capacity, from 1000 to 5000 barrels at 65% of their capacity, from 5000 to 10,000 barrels at 60%, from 10,000 to 20,000 barrels at 50%, and over 20,000 barrels at 40%. When salt water appears the exploitation is to be decreased so that the proportion of salt water and sediment does not exceed 5%. G. S.

72. Producing and Prospective Oilfields of Africa. Cull and Co.'s *Financial Review*, December, 1925.

Morocco.—Oil indications have been met with in Northern Morocco, between El Araish and Fez, and in 1912 petroleum was said to have been obtained by drilling. In 1920, petroleum was reported at Djebel Selfat and developed at a depth of 200 feet. It is suggested that petroleum will be found in Miocene sands and clays associated with igneous rocks.

Algiers.—The Algerian Oilfields, Ltd., are producing oil in small quantities from their concessions in the Department of Oran. Up to the end of October, 1925, their total production had amounted to 3561 metric tons. Crude oil from Ain Zeft has a sp. gr. of 0·97 and contains 3½% petrol and 95% paraffin, and that from Relizane having a sp. gr. of 0·83 and containing 5½% petrol, 54% kerosene and 4% paraffin.

Tunis.—Although indications of oil at several localities led to exploration work being carried out and to several wells being sunk, these did not result in the finding of oil in commercial quantities.

French Equatorial Africa.—In Madagascar several wells have been sunk, but without result, although geological reports point to a potential field.

Uganda.—What appear to be indications of oil have recently been discovered in the Lake Nyanza region, but nothing has been definitely determined.

Central and South Africa.—Oil indications are met with in numerous localities in the Union and give promise of future oilfields. In British Somaliland, oil having a sp. gr. of 0·897 has been discovered at Daga Shabell and in Southern Nigeria an oil of 0·872 sp. gr. has been found. In the Appollonia territory, an oil of 0·979 sp. gr. is collected in pits and in French West Africa, near Tano Lagoon, oil was met with in bores, but not in commercial quantities.

Angola.—Although for many years expeditions have been in search of oil, so far no oil in commercial quantities has been located.

Egypt.—The two producing fields of Egypt are Gemsah and Hurghada, the production from the latter being between 3200 and 3500 tons per week. The total production of oil in Egypt up to the end of 1924 has been 819,626 tons, the figure for January to October, 1925, being 149,265 tons.

G. S.

73. Weigh Your Pumping Wells and Avoid Many Belt and Rod Troubles. A. F. Hinton. *Nat. Petr. News*, **17**, 51, 33—34, 1925.

Saving in belt replacements is effected by determining the work a belt will be called upon to do, and then installing the proper belt to withstand the strain. Two types of well-weighing devices are illustrated and by their use weight of pumping equipment is measured and the total load on the beam or pumping power arrived at. G. S.

74. Use of Compressed Air or Gas on Sand may Solve Tonkawa's Problem. A. F. Hinton. *Nat. Petr. News* **17**, 46, pp. 46, 48, 1925.

Most of the deep wells in the Tonkawa sand have now ceased flowing and present a problem in finding successful methods to keep them productive. A large number are being swabbed, but the recent application of the air-lift principle may mean the saving of many wells. In one case the residue gas from a gasoline plant is used in place of air. This is compressed to about 300 lb., blown through the well, inducing a flow of oil, and then recovered and stripped of the gasoline which it has adsorbed from the oil. G. S.

75. Water Circulating System Uses Air-Lift Principle. *Oil Trade J.* **16**, 12, 22, 1925.

This article describes the application of the air-lift principle to water circulation for cooling engines, the whole of the equipment used in this particular case being scrap material. G. S.

76. Unusual Types of Pumping Equipment are Used in Kansas Fields. Lawrence E. Smith. *Nat. Petr. News* **17**, 46, 53—55, 1925.

A large number of long-stroke pumps of various types are in use in Kansas. In one case the cable is wrapped round a drum motor-driven through double reduction gears. One end of the cable passes over a large *sheave* into the well and is attached to the rods, and the other end passes over a similar *sheave* into an old well and is attached to a counterbalance. By means of a magnetic control it automatically reverses and so imparts reciprocating motion to the pump rods. In another type the drive to the drum is by

three-gear reduction moving two discs. The discs, by connecting rods and crank pins, actuate two sliding racks which are in mesh with pinions on the main shaft, the shaft being driven first in one direction and then the other. In this case the counterbalance is a concrete block running in a pipe framework. A jack type of pump, providing up to 5-foot stroke with 20 strokes a minute, is also in use and is designed to give a straight pull.

G. S.

77. Apparatus for Separating and Extracting Mineral Oils from Oily Sand, Bitumen from Oily Chalk, Oily Slate, Coal, etc. H. Preller. U.S.P. 1,567,983, 29.12.25. Appl., 9.12.22.

A reservoir containing a treating liquid contains a set of drums, the alternate drums rotating in opposite directions, causing the material treated to advance in a zigzag path. H. M.

Coal and Shale.

78. Artificial Petroleum from Balkash Sapropelites. N. D. Zelinsky. *Brennstoff-Chem.*, 1925, **6**, 365—369.

The sapropelite deposit from Lake Balkash, known as Elaterite, shows considerable difference from ozokerit, even by a superficial examination, and probably is akin to the bitumen named "algenwachs," and to Boghead coal. It may be regarded as of interest as throwing light on the possible origin of petroleum from organic materials. It is found as a dry elastic mass, and burns with a smoky flame and an odour of tallow and fatty acids. Its water content got by drying at 110° C. was ·18% and ash content on igniting only 4%. The organic portion gave on analysis 73·76% carbon, 10·91% hydrogen, 1·03% sulphur, 0·56% nitrogen, a trace of phosphorus and 13·74% oxygen. It is distinguished from other sapropelites by its large carbon and hydrogen contents, and the small nitrogen and sulphur content and absence of phosphorus gives rise to the supposition that it is of vegetable origin. It was found that ether extracted 27% of organic matter from sapropelite, and the extract contained more free solid acids than waxes. Carbon disulphide as a solvent gave 32% of extract, and carbon tetrachloride 39%. On extracting the residue from the latter solvent with ether further 3·1% was obtained. On dry distilling 57% of a liquid tar was obtained, and 6·2% more on redistillation of the residue. On refining and redistilling with steam the tar yielded 12·6% of a light benzine fraction, or 78% on the original sapropelite and of kerosene fractions 54·6% on tar or 26% on the original material. The latter fraction contained 30% of unsaturated substances, and the fractions corresponding to solar oils, 35% to 40%. The benzine before refining with sulphuric acid had an aromatic, fatty smell, but after refining an odour of ordinary benzine. The sp. gr. was 0·726 and it consisted principally of hydrocarbons of the C_nH_{2n-2} series. The petroleum fraction was quite colourless and had only a feeble action on potassion permanganate. Its sp. gr. was 0·794. H. M.

79. The Development of a Standard Canadian Laboratory Distillation Method for Examination of Oil Shale. R. E. Gilmore and A. A. Swinnerton. *Canad. Chem. and Met.*, 1925, **9**, 215—217, and 235—239.

I. The results of retorting a standard shale sample with an oil content of about 30 galls. per short ton by various current methods are tabulated. The apparatus employed comprised a cross-section retort of 3,500 g. capacity immersed in a lead bath electrically heated, 3,000 g. of shale being used and

the temperatures raised to 550° C.; the large field assay retort used by the U.S. Bur. of Mines, charged with about 350 g. of shale and heated in an electric furnace; a small field assay retort, charged with 100 g. of shale, heated by a gas burner or in an electric furnace; and a horizontal iron tube 2½ in. inside diam. and 26 in. long heated in a gas furnace, and charged with 450 g. of shale.

II. The Scotch tube method used at Pumpherston was also employed. This comprises an iron tube 2 in. in diam. and 6 ft. long, closed at one end and open at the other. This is charged with 450 g. of shale and treated in a furnace in an inclined position, so that the distillates run out of the open end and are collected in a beaker. Examination by distillation of the crude oil was carried out in an Engler flask on a quantity of 100 c.c. and in a Hempel flask on 300 c.c. The lead bath retort was found to be cumbersome and inconvenient, and the two assay retorts were found to be most convenient and accurate in results. The large assay retort yielded sufficient crude oil for an Engler distillation and was preferred. The Scotch tube method gave only 29 galls. oil per ton, while the small assay retort gave 32 galls. and the large assay retort about 31 galls. The yield of gas varied from 1095 to 1635 cb. ft. per ton without the use of steam, but reached 4020 cb. ft. when steam was used. The yield of gas and amount of carbon in spent shale were in inverse proportion. The crude oil from electrically-heated large assay retort had a sp. gr. of 0·881, and on distillation yielded 8% up to 150° C.; 31% 150—300° C., 46% 300° C. to end point, with 15% pitch and loss. H. M.

80. Holzheim Shale and Shale-oil. K. Neubronner. *Petroleum Zeitschrift*, 1926, **22**, 57—61.

The shale from Holzheim (Würtemberg), which contains 16·1% total organic material, yields, at 350°—570° C., 6—7·5% shale oil. The latter has specific gravity 0·960—0·965 at 15° C.; viscosity 4—5° E. at 20° C., 1·7—2° E. at 50° C.; flash point 65—70° C.; flow point 6°—10° C.; initial boiling point 125°—130° C., 8% distillate at 200° C., 66% distillate at 360° C. (soft pitch residue); total cal. value 9900—9950 cals./kilo.; 0·3—0·4% asphalt insoluble in benzine; 0·7—0·8% paraffin wax; 0·01—0·06% ash; carbon, 82·2—83·0%, hydrogen 10·0—10·2%, sulphur 2·3—2·7%, nitrogen 1·45—1·7%. The oil contains saturated and unsaturated paraffin hydrocarbons, naphthenic hydrocarbons, mercaptans, aldehydes and ketones, and aliphatic substances resembling esters. The small quantity of aromatic substances include benzene, toluene, ethylbenzene, the three xylenes, and pyrrole, but not naphthalene or thiophene (or its homologues). There are also present traces of phenol, the three cresols, xylenols (chiefly the 1 : 3 : 5 isomeride), guaiacol, pyridene, picoline, lutidine, and collidine. W. S. N.

81. Reducibility of Cresols by the Bergius Process. F. Fischer and H. Tropsch. *Brennstoff-Chem.*, 1926, **7**, 2—3.

When *o*-, *m*-, and *p*-cresol are heated at 460° C. in an atmosphere of hydrogen at 240—245 atmospheres, for a period of, respectively, 400, 100, and 75 mins., toluene (4·5—1·3%)—by reduction—and phenol (1·5—8·0%)—by elimination of the methyl group—are produced. W. S. N.

82. Reduction of Cresols. G. Stadnikoff, N. Gawriloff, and A. Winogradoff. *Brennstoff-Chem.*, 1926, **7**, 7—9.

Technical cresol is reduced to toluene in 80% yield by the following process. Asbestos is impregnated with ferric nitrate and the latter converted by treatment with ammonia into ferric hydroxide. The air-dried, pulverised

material is dried in a current of air at 300° C., and the oxide reduced in a current of hydrogen at 380° C. for 3—4 hours. The temperature is now raised to 480—500° C. and 3—5 drops per minute of cresol introduced, a slow current of hydrogen being simultaneously maintained. At first decomposition of the cresol occurs, giving hydrogen, carbon monoxide, carbon dioxide, and carbon; the latter, deposited in an active form on the active iron, now forms the reducing medium for further quantities of cresol. As soon as hydrocarbon appears in the product, the temperature is gradually lowered to 430° C. and the feed of cresol somewhat increased. The gaseous product now contains 10—14% carbon dioxide and 5—8% carbon monoxide. Not more than 2—3% of cresol is present in the toluene formed. Good yields of hydrocarbon are likewise obtained if hydrogen is replaced by carbon dioxide or nitrogen. It appears that the cresol is reduced by the carbon in contact with the active, and activating, iron, and that as this carbon is used up, more is formed by a fractional decomposition of the fresh supply of cresol, brought about by contact with the exposed, active iron. Hence (from the known oxygen content of cresol) under the best possible conditions of temperature, etc., not more than 92·5% of the cresol can be converted into toluene. Of the isomeric cresols, the *para* compound reacts the most readily. The presence of sulphur compounds in commercial cresol from certain sources may cause a rapid conversion of the active iron into inactive iron sulphide; the useful life of the catalyst will then be very short. This applies to cresol from lignite tar or coal tar, favourable results being, however, obtained when using cresol from peat tar. W. S. N.

83.—Oil Shale Retort. S. H. Corfield. U.S.P., 1,562,541 of 24th Nov., 1925. Appl. 10th May, 1922.

The retort comprises a casing closed at the top and the bottom, and through which the oil shale is passed. The casing contains a number of superimposed tables, and a central vertical support carries baffle plates to direct heat around the tables. Scrapers above each of the tables are carried by a skeleton frame, and blades are cut in the scrapers and staggered in relation to the scrapers. The rotation of the scrapers moves shale from one table to the one below it through openings offset from each other in the tables. H. M.

84. Oil Shale Retort. J. T. Pope. U.S.P. 1,564,271. 8.12.25. Appl. 24.10.22. Received 29.6.25.

The retort consists of a sheet metal casing surmounting a furnace. Direct heating is prevented by means of firebrick slabs interposed between the casing and the furnace. An inclined table, capable of small longitudinal movement, is suspended in the metal casing and conveys crushed shale from one end of the retort to the other, entry and exit of the shale being controlled by roller gates. Superheated steam is distributed along the surface of the shale and a vapour offtake is provided. T. A. S.

85.—Process of Recovering Oil from Shale. C. S. Fogh, Assr. to Ore Roasting Development Co. U.S.P. 1,563,271 of 24th Nov., 1925. Appl. 26th Nov., 1920.

The volatile constituents of oil shales and oil sands are vapourised by a continuous process in which the material is heated during its passage through a gas-tight, mechanically-rabbled furnace by heated non-oxidising gases. The gases carrying the volatile constituents are continuously removed from the furnace, and their volatile constituents condensed. The fixed gases are reheated and again passed into the furnace. H. M.

86. Improvements in Methods of Separating Phenols from Crude Oils. *V. L. Oil Processes.* Lucas and Lomax. E.P. 242,092, 1925.

Caustic soda of a strength exceeding 20%, *e.g.* 30% is used to extract the phenols from crude oils obtained by the distillation of coal, lignite and the like; 20% soda combines only with the theoretical quantity of phenols, whereas soda of greater concentration forms sodium phenate in which the excess of phenols will dissolve. The phenol solution is separated, diluted, the liberated phenols removed and the lye concentrated and used again. If soda of greater strength than 30% is used, it retains neutral oil in an entangled state. This can be removed by steam distillation before separation of the phenols. H. G. S.

87. Benzols, Extraction From Heavy Oils. E. A. Barbet. U.S.P. 1,561,899.

The process relates to the treatment of heavy oils used for the extraction of volatile constituents from coke-oven gases, etc., and comprises the heating of a mixture including such oil first by the heat of outgoing stripped oil and by the naphthalene-carrying vapours. The preheated oil is then run through a column still, including a rectifying column, and heated by indirect steam heat to about 160° C. Vapours are drawn off at the lower part of the rectifying column and the unvolatilised oils are further heated by superheated steam to vapourise the naphthalene. G. S.

Abstracts.

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General.

88. Report of Surgeon General's Committee on Tetraethyl Lead. *Ind. Eng. Chem.*, 1926, **18**, 193—196.

As a result of observations made over a considerable period of time on 252 individuals, the following information has been obtained.

Drivers of cars using as a fuel ethyl gasoline, in which the concentration of lead tetraethyl does not exceed 1 part in 1,300 parts by volume of gasoline, showed no definite signs of lead absorption after exposures approximating two years. Employees of garages and service-stations handling ethyl gasoline showed evidence of lead absorption and storage. The effect, however, was slight in comparison with that of men working under conditions where a severe lead hazard existed (lead dust) and, over the period studied, was insufficient to produce detectable symptoms of lead poisoning. In the regions where ethyl gasoline has been used to a greater extent for a period of from 2 to 3 years, no recognisable case of lead poisoning or disease, produced by lead tetraethyl, has been noticed. The only actual cases of poisoning by lead tetraethyl have been amongst employees at plants engaged on its production.

S. F. B.

89. Regulations in Searching for, Prospecting for and Working Oil Deposits. (Sanctioned and issued by the Government). The *Russian Mining Journal*, No. 1, p. 79.

Searching.

(P. 196) The searching for oil, unaccompanied by excavations, is regulated by P. 12-15 of the present instructions.

(P. 197) The searching for oil sources, accompanied with excavations is regulated by P. 16-18, 20-24 with the notes to Ps. 25 and 27 and P. 29 of the present instructions, with the following modifications.

(P. 198) Before commencing work the searcher must obtain, from the local Mining District Chief, a certificate giving him the right, for one year, to carry out the designated work on an area of 360,000 sq. sag. with a meridional direction on two sides, in the centre of which he must fix a claim post.

(P. 199) In searching for oil, areas cannot be granted that are already occupied by other mining Prospectors in searching for, prospecting for and working all sorts of minerals, in conformity with Ps. 27 and 33, note "B"

to P. 50, Ps. 76, 77, note " b " to P. 130, note " A " to P. 40, and Ps. 174, 182 and 198.

(P. 200) The carrying out of search work by one oil producer, shall not prevent other persons from searching and prospecting for oil and other minerals provided that the claim post of these latter are put no nearer than 600 sag. to the claim post of the former in a latitudinal or longitudinal direction.

(P. 201) The searching for oil by the oil producer can extend beyond the limits of the area fixed in Par. 198 to places free of oil claimants, as well as to areas occupied in the authorised manner by other mining Industrials in searching, prospecting or obtaining otvods for all minerals (not excluding oil) provided that such work does not impede and damage the work of these mining Industrials, and can be permitted only with the sanction of the local mining department. Such work, however, does not give the oil producer the right to obtain a prospecting area outside the limits fixed by the aforesaid claim post.

(P. 202) Within the limits of the area designated to searching for oil other mining Industrials are not permitted to carry out the searching and prospecting for other minerals than oil.

Prospecting.

(P. 203) Prospecting for oil is regulated by P.P. 30-32, 34-46, 60 with notes, 51-54, 56-60A of the present instructions with the following modifications :—

(P. 204) The size of the area reserved by the oil prospecting certificate is defined at 360,000 sq. sag. and must conform in shape and boundaries to the searching area (P. 198) and its centre must be designated by a prospecting signpost. The indicated area, whether in subordination to local conditions, or at the desire of the oil producer himself, can be diminished to 240,000 sq. sag., but not otherwise than with the sanction of the local Mining Authorities in each separate instance.

Note.—Besides the separate instances foreseen in the present paragraph modifications of the above-mentioned form of prospecting areas of whole districts may be realised only by the decision of the W.C.O.E. of the C.F.S.R.

(P. 205) From the moment of issuing the oil prospecting certificate a site of square expanse of 360,000 sq. sag. measuring 300 sag. to the North East, West and South of the prospecting sign, erected by the bearer of the certificate, is declared non-available and other Mining Proprietors have not the right to erect within this area their own prospecting posts.

(P. 206) A permission certificate to prospect oil deposits may be issued to the oil producer not only in the event of him having discovered oil within the limits of the searching area reserved to him, but also in the event, if signs of oil bearing, though not discovered by him nevertheless are the result of the work (uncovering, trenching, sinking pits, drilling, etc.) carried out by him and give grounds for assuming the presence of oil beds, on the area applied for, upon its further investigation by more detailed or deeper workings.

In the latter event the applicant must produce data upon which depends the possibility of the presence of oil in the designated area, also define the place and time of discovery of bed, as required by P. 37 of these instructions, when handing in his application to the Mining Authorities.

(P. 207) The inspection, indicated in P. 41 of these instructions, of the area solicited for prospecting, by the Chief of the Mining Department is obligatory, in cases foreseen in P. 206 of these regulations.

(P. 208) The right to obtain an area for oil prospecting is available not only to the first discoverer of the oil deposit, carrying out search work (P. 31 present instructions) but in his obscurity to the first declarer thereof (P. 36), or to the person carrying out search work in accordance with P. 206 or to the oil producer furnishing geological data concerning the yet unknown oil beds and pointing out the probability of its presence in the designated area.

The application of such oil producer nevertheless is subject to satisfaction only, in the event of the area solicited for prospecting, not being occupied in the established order, by other Mining Proprietors in search or prospect work and does not infringe on other sections of exempted places upon which, search work for oil is already being carried out by other oil producers in virtue of P. 201 of these instructions.

(P. 209) In modification of Note B to P. 50 of these instructions the choice of situation of the oil prospecting area, applied for in the defined district is at the discretion of the applicant, but nevertheless this area must conform to the requirements of P. 204 of these present instructions.

(P. 210) In those instances when on either of the areas, reserved to the oil producer for searching or prospecting for oil, he shall discover a deposit of industrial significance (with a flow of oil of not less than 100 poods daily on an average) the land adjacent to that area, enclosed within a radius of 2½ versts from the point of discovery of the bed is, for a term of six months from the moment of discovery declared prohibited for the issue of permissive certificates to other oil producers for searching and prospecting for oil as authorised by P. 208 of these instructions.

Certificates of searching and prospecting for oil issued previous to this discovery, nevertheless retain their authority with all the holder's rights arising therefrom, although such corresponding areas on these certificates are contained within the area of the above-mentioned radius.

Simultaneously with the decision of the above-mentioned prohibition the Chief of the Mining Department puts up a notice to this effect in his and the local Executive Committee's offices and according to established order, informs the Mining Department of the W.C.O.E. of the C.F.S.R., with a view to obtaining the further instructions of this Authority as to whether this locality is closed for searching and prospecting on the rights of the first discoverer in accordance with Art. 5, Statutes of the earth's interior, or if it is free.

(P. 211) The holder of the permission certificate for oil prospecting also has the right to prospect for kier, ozokerite, natural gas, as well as to prospect and obtain building material and other generally diffused minerals within the limits of the requirements in connection with his work. To prospect for other minerals on the same area is not permitted him otherwise than with the sanction of the local Chief of the Mining District.

(P. 212) Searching and prospecting for minerals other than oil (P. 201) by subsequent Mining Industrials, is prohibited within the limits of the area reserved for oil prospecting while the permissive certificate remains in force.

(P. 213) The term for prospecting areas for oil is fixed at two years, In individual, especially admissible cases, this term may be prolonged to three

years by the W.C.O.E. of The United Republics, Trade Bureau and People's Commissary of Trade and Commerce upon representation by the local Chief of Mining District.

NOTE.—The stated term of two years in this present paragraph may be prolonged to three years by sanction of the local District Mining Chief, in cases foreseen by P. 208 of these regulations.

(P. 214) The method of carrying out the prospecting work is at the discretion of the oil producer, but during the term reserved to him for prospecting he must geologically map out the prospected area to a scale of 50 sag.=one inch, and also fulfill all work enlightening the degree of industrial significance of this area, the requirements of P. 56 with Notes and P. 57, in relation to this latter work, remaining in force.

NOTE.—The geological map based on the geological work of the prospected area must be presented by the oil producer, together with a detailed account, to the District Mining Chief.

(P. 215) Foreseen in P. 60a of the present regulations, the dole-share of kier, ozokerite (P. 211) mined while oil prospecting, is collected in the proportion of 5%. Natural gases, obtained while prospecting, are free of the dole-share.

(P. 216) Upon completion of the prospecting work and carting away equipment (P. 60 of these instructions) belonging to the oil producer from the prospected area he must, without recompense, leave the casings in those of the wells drilled by him, which shall be pointed out by the Mining District Chief, and liquidate, in the manner proposed by the Mining District Chief, those wells detrimental to the oil deposit, pointed out to him.

(P. 217) For the right to prospect on the areas reserved for this purpose, the oil producer pays a prospecting tax in accordance with Ps. 2-5, Regulations on the order of collecting payments.

The order of preferment of otvods for working oil.

(P. 218) The preferment of otvods of oil bearing areas is regulated by Ps. 61-75 of the present regulations with the following modifications and additions:—

(P. 219) Material for mapping out the prospected area and also a project plan of the otvod must be annexed by the oil producer to the application for granting an otvod for oil working (P. 61 these instructions) besides money for publication.

(P. 220) The oil producer has the right to choose 4 otvods on the prospected area granted him provided that these otvods: (*a*) must lie immediately adjacent one to the other, (*b*) must not extend beyond the limits of the prospecting area, (*c*) must be of a rectangular form with a meridional direction on two sides, (*d*) have in width not less than one-third its length.

The size of one otvod is established at $^1/_{13}$ of the area reserved for prospecting.

(P. 221) The residue of the prospecting area after apportioning to the oil producer his otvod for working (P. 220 these instructions) enters into a special government fund of oil bearing lands, prohibited for exploitation to the first discoverer, the disposal of these indicated lands being regulated by Art. 5, Statute of the earth's interior, and by special regulations issued by the W.C.O.E. of the C.F.S.R. in development of this Statute.

(P. 222) The rights and obligations of the oil producer, foreseen in Ps. 60 and 216 of these regulations, in relation to the prospecting areas, comprising

the Special Government fund of oil-bearing lands (P. 221) are maintained.

The Rights and Obligations of otvod beneficiaries.

(P. 223) Within the limits of the otvod, homologated to the oil producer, he benefits by the right to obtain kier, ozokerite and natural gas, besides oil. Mining all sorts of commonly distributed minerals and building material, on the otvod, is permitted the oil producer only within the necessities connected with the exigences of field work carried out on the otvod.

The acquiring of other minerals on the otvod may be carried on by the otvod beneficiary not otherwise, than with the sanction of the conforming W.C.O.E. of the United Republic Trade Bureau and the Peoples Commissary of Trade and Commerce in accordance with Ps. 86 and 87 of the present instructions and only in that case where such acquisition does not infringe the conditions of the correct working of the oil beds in a technical and economical relation and does not contravene the rules of safe conduct of mining work.

(P. 224) On the otvod granted to the oil producer, other Mining Proprietors are not permitted to carry out whatsoever search, prospect, and acquisition work, with the exception only of searching for oil (P. 201).

(P. 225). The oil producer upon taking up the mining otvod has the right to the whole surface covering the otvod.

The order of granting the otvod beneficiary the section of surface is regulated by the general rules: "The order for granting otvod sections of surface for the necessities of the mining profession" confirmed by the W.C.O.E. of the C.F.S.R.

(P. 226) Within the boundaries of the mining otvod granted to the oil producer, he has the right to erect all sorts of structures and buildings required by him for drilling, acquiring, pumping, storing, delivery of oil and furnishing of materials. All other buildings, establishments and structures, required by him for oilfield service, as also refineries, are erected on those sections of surfaces, especially allotted in virtue of the rules denoted in P. 225 of the present "instructions, outside the limits of the otvod granted him.

(P. 227) Concerning the order and conditions of carrying out oilfield work, the demands of Ps. 92-95 are applied, and the oil producer, beyond this, must submit to all published rules and decrees of the Mining Inspection concerning the flooding of the oilfield, regulating fountain oil, laying pipelines and observe all anti-fire measures, regulations for storing oil and also the accounting of oil, winning, and delivery off the field.

(P. 228) Sub-letting rights to an otvod is regulated by Ps. 96-98 of the present instructions.

(P. 229) The rules foreseen in P. 99-107 of the present instructions may not be applied to the oil-producer previous to the expiration of a year's term from the day of him taking over the otvod, but nevertheless he must, before the expiration of this term, proceed to uninterrupted, capital drilling of a well. Not having entered upon the indicated drilling within the indicated year's term, without sufficiently satisfactory reasons, gives the Organ issuing the otvod act, the right to apply P. 103 of these present instructions.

(P. 230) In the event, if within the limits of the otvod granted to the oil producer, it shall be decided to erect any kind of structure of Government significance, owing to which the oil producer will be deprived of the possibility of working the whole or part of the otvod granted him, or shall suffer damage through being impeded in taking advantage of the otvod surface granted

him, he has the right to demand legal redress from the Government recompensing him for this loss, provided that a mutual agreement, upon this subject, has not previously been agreed to.

(P. 231) The relationship of adjoining otvod beneficiaries and their relation to beneficiaries of neighbouring sections of surfaces are regulated by Pa. 113 and 116 of the present instructions.

W.C.O.E.—The Whole Council of Oil Economy.

C.F.S.R.—The Council of Federated Socialistic Republics. T. W.

90. The State Royalty of Petroleum Industry. I. Strizoff. *The Mining Journal*, No. 3, p. 152.

By decree of the earth's interior dated July 13th, 1923, the S.C.N.E. proposes to pay the Government a dole share of all minerals mined. This share should not exceed 5 per cent. on estates taken by declaration. In working already known deposits, leased by agreements according to Art. 25 of the decree, the rate of payment is not fixed by the decree. Up till the present, Azneft, Grosneft and Embaneft paid the local republics at the rate of about 1 cop. per pood. The Narkornjin demands 2½ cops. per pood as Government revenue.

The question of the dole share of oil produced is a very important and complicated one. The Government for the first time on new grounds has to establish the dole share on working the interior, and pre-war practice and the practice of capitalistic countries do not give sufficient material to decide this question, as the basis and form of economy are otherwise with us.

Payment for the interior, otherwise, payment for produce gained from the interior, is a payment to the proprietor of the interior and the Government is the proprietor.

If we take into account those prices and conditions, under which estates were leased before the war in Russia, and under which, at the present time estates are leased in the U.S.A. it will be seen that the dole share is not especially high. Only in separate cases has the dole share reached an exorbitant rate.

If an average is taken of the poodage payment and dole share, made by the firms in Baku and Grosny before the war, it is evident that, for 1913, these amounted to, in Grosny, less than 10 per cent. of the price of the produce, while in Baku it was about 3 cops. per pood or 7 per cent.

The share dole, or payment for the interior, we should consider as payment for the substance itself.

Up to the present this price for oil has been incorrectly fixed by basing it on the self cost of production. What did this self cost comprise ?

The calculations for self cost are well known. They are classified in detail and consist of fixed elements: wages and salaries, materials, fuel, etc., etc. Analysing this calculation, one important element—payment for the substance itself—is not discoverable.

In fixing the price of oil from the self cost of production, only the expenses of producing oil were included ; where is the payment for oil as for a substance? Nevertheless oil is an exceedingly valuable product. This liquid is exceedingly convenient for circulation and in burning develops an enormous heat.

There should be one payment for the one oil all over the U.S.S.R.

There are no grounds for demanding that one Trust should pay the proprietor of the interior one price for oil, and another Trust a different price for such similar oil.

The dole share or payment for the interior may be compared to the mining talliage, which before the war, was collected by the Treasury from certain useful minerals. This mining talliage was the same all over Russia.

The royalty on oil should comprise two main elements: (1) The price of oil as a substance, and (2) the producing costs including amortisation. Up till now we have gratuitously taken a substance from nature and passed it on to the population without a payment for the substance itself.

To the question what is the value of the oil as a substance, besides the cost of producing—it is extremely difficult to answer. This question requires to be technically and economically analysed.

Taking into consideration the technical and economical conditions we draw the conclusion that payment for oil, as for a substance, in the near period of time should vary between 1 and 3 cops. It would be rational to fix the payment for the substance at the rate of 10 per cent of the cost of producing this substance. At present prices of oil this would be about 3 cops. per pood. But, as the oil industry is in an extremely difficult position, the price of oil very low, capital expenditure curtailed, excessive obligations in payment of other deductions are put upon the oil industry, taxes, etc., high excise holding back the sale of oil-products, railway tariffs, etc., etc., it should be acknowledged that, while the present financial and economical conditions exist, even 2 cops. per pood would be an excessive payment for oil, as for a substance. This 2 cops. has not entered into the self cost calculations, accepted by the S.C.N.E. and did not enter into the financial plan. In this self cost is included only 1 cop., another extra cop. being added, by the Council of Labour and Defence after establishing the plan and commercial price.

Under the conditions in which the oil industry is placed it is not possible to fix a dole share deduction, *i.e.*, a payment for oil as a substance higher than 1 cop. But this figure is irrationally low and the populace and the industries of the U.S.S.R. must pay for the oil, not 1 cop., but more.

There are defenders of the principle that payment for the interior, or royalty for oil should not be of one and the same rate for all deposits or trusts, but of various rates conforming to the richness of oil deposits and other conditions.

This principle means that the one who could pay more should be charged dearer; and to take more from those oil deposits, which give a larger production and a cheaper oil.

An analysis of the conditions, in this connection, show that they may be: (1) The richness of the oil deposit, and (2) the cheapness of production.

The best expression of the richness of the interior would appear to be the average daily production per well. Of two wells—one giving 100 poods daily and the other 1,000 poods, it would seem that the second well should pay about ten times as much as the first, as a dole share. But other circumstances play their rôle, as for example, the depôt of the well, the cost of drilling, the amount of water raised with the oil, as well as the quality of the oil itself, etc., etc.

One hundred poods of oil daily from a well 100 sag. deep will be more profitable than 200 poods of oil daily from a well 500 sag. deep; 100 poods daily will redeem a shallow well but 200 poods daily will not redeem a deep well.

From this it will be seen that a basis cannot be taken on the production only. The depth of well, the cost of the well and other circumstances should be taken taken into account, and all this will more than complicate the question.

Besides the quality of the oil should be taken into consideration. Paraffin oil may cost more than non-paraffin. Benzine oil may also cost more than oil containing very little benzine, etc., etc.

Finally, this would lead to a deduction from the profits instead of a payment for the interior and this would mean that we were on the wrong road. The only correct decision of the question is as above formulated: The dole share, deduction, or payment for the interior is a payment for oil, as for a substance.

There must be a unit payment for a unit substance. There must be an identical payment for the identical oil.

There arises the question of the similarity of the oil itself. All oil is approximately alike in number of calories. But in relation to the extraction of other products from oil there is a difference in the various kinds of oil.

In Grosny there are three types of oil: paraffin, paraffinless, and slightly paraffin.

In Baku there are the following types: Kerosine, light lubricant, heavy lubricant and fuel oil.

We think that, at present, the payment for the interior should not be corrected with the kinds of oil. This will only complicate the question all the more and bring us no great advantage. We are still in the preliminary stages of production and are making a road for the new construction of the oil industry. A technical rationality of production is being carried out. As a result of this rationality we shall more fully utilise the qualities and integral parts of separate oils. Then a dole share deduction can be fixed according to the kinds of oil.

During the five years' period of technical rationality one identical dole share deduction should be established for all kinds of oil.

If for coal the dole share deduction is $\frac{1}{4}$ cop. per pood, then it follows from this figure that for oil it should be $\frac{1}{4}$ cop. per pood, inasmuch as 1 pood of oil replaces 2 poods of coal:

In conclusion, it is proposed that one unit share dole deduction should be fixed for all oil deposits, at its former rate of 1 cop. per pood. T. W.

91. The Great Oilfield on the Canadian Border. *Oil News*, January 30th, 1926.

The Kevin-Sunburst oilfield is situated in Toole County, Montana, about 20 miles north of Shelby, and 15 miles south of the Canadian Boundary. The possibility that the Sweetgrass arch would yield oil was first noted in 1916, but the area was not tested until 1922, when oil was struck in March of that year by the Gordon-Campbell well. The field lies in a treeless plain bounded on the north and west by a bold escarpment which is capped by the Virgelle Sandstone. Much of the surface deposit of the plain is composed of glacial drift and lake deposits forming a bed in places of as much as 200 feet in thickness. Below this drift, the Virgelle Sandstone is found. It is a hard, cross-bedded sandstone of Upper Cretaceous age, and about 200 feet thick. The Colorado Shale which underlies the Virgelle bed is also of Upper Cretaceous age, is about 1,800 feet thick, and is the oldest formation exposed within the field. The upper part consists of 1,000 feet of blue and brown shale, with layers of bentonite, sandstone, and fossiliferous concretions; while the lower part, known as the Blackleaf bed, is a sandy facies of the Colorado shale of about 770 feet in thickness.

Below this lies the Kootenai formation of Lower Cretaceous Age and 405 feet in thickness, comprising sandstones and varicoloured shales. The Sunburst sand is the lowest member of the Kootenai, and yields most of the gas, and a small part of the oil produced in this field. In many of the wells a bed of distinctly yellow shale or sandstone of the Ellis formation underlies the Sunburst sand, and marks the contact of the Kootenai formation. The latter is of Upper Jurassic age, varies between 200 and 250 feet in thickness, and consists of calcareous shale or shaly sandstone with interbedded black shaly limestone.

Most of the oil now being produced is obtained from a thick "sand" which marks the base of the Ellis formation, and lies unconformably on the Madison

limestone. The latter is of Lower Mississippian Age and about 770 feet in thickness, and usually consists of massive limestones.

In this field the Devonian is believed to be represented by 330—350 feet of black shale and limestone which is correlated with the dark Jefferson Limestone of the Little Rocky Mountains, and a dark thin-bedded limestone of the Sweetgrass Hills area. Below the Jefferson limestone there exists a formation of 275 feet of anhydrite, which is reputed to be of Silurian age.

The early Palæozoic rocks are represented by 900 feet of dolomitic limestone, anhydrite and shale of Ordovician Age, underlain by grey shales and quartzites of Cambrian age.

The developed oilfield lies on the north-west side of a very broad dome which shows few minor irregularities. The highest part of the dome near the Troy-Sweetgrass well is only about 500 feet structurally above the Campbell Sunburst wells, which are more than 10 miles away.

The basal sand of the Ellis formation is the principal source of oil, although some is obtained from the Sunburst sand, and from sands in the upper part of the Ellis formation. Gas and oil in small quantities have also been found in the Upper Kootenai, Lower Colorado, Madison limestone, and in the Jefferson limestone. The oil from the Sunburst sand has a dark colour, an odour like gasoline, and a gravity of about 35° Bé. That from the basal sand of the Ellis formation is nearly black, has an odour of sulphur, and a gravity of about 30° Bé.

A map is given showing the location of the field, stratum contours, outcrops, dips and strikes, etc. W. H. T.

92. Oil for Canada from her Tar Sands. R. B. Day. *Oil and Gas Journal*, 1925, **24**, (14), 21, 130.

The following methods are suggested for utilising the bituminous sands from the Athabaska region of Canada. (1) Separation of the oil and sand by extraction with solvents, hot water, or mud. (2) Mixture of the sands with dry sand or crushed limestone, for use as paving materials. (3) Destructive distillation in closed retorts. The third method is to be preferred, because the heavy oil obtained yields on cracking, 25% of gasoline and 30% of kerosene, leaving a residue which may be cracked again. W. S. N.

93. The Petroleum Between Bagdad and Mosul. A. F. von Stahl. *Petroleum Zeitschrift*, 1926, **22**, 372—373.

A geological account of the oil-bearing district to the east of that section of the Tigris between Mosul and Bagdad.

The high Kurdistan mountains to the east of the Tigris, in Persia, consist of gneiss and granite, overlaid at the base with sediments of the lower Jurassic and of the Cretaceous. Towards the south-west, in the neighbourhood of the Persian-Turkish boundary, the Cretaceous is itself overlaid with Eocene deposits, which reach a thickness of 250 metres, and which consist of the following rocks (beginning with the lowest): (*a*) Yellowish chalky marl, somewhat more clay-like in its lower strata, (*b*) thin bands of yellow sandstone, (*c*) thin bands of coarse sand with coloured hornstone, (*d*) thin bands of limestone with red sandstone breccia, (*e*) heavy white marl and chalk, (*f*) heavy white hard marble. These strata are very extensive and extend along a north-west to south-east line, past the towns of Disful, Schuschter, Ram-Hormuz, and Schapur (which are built on the Miocene sediments), to the plain of Schiraz. The petrographical and palæontological character is, however, somewhat different in the south-east.

Towards the south-west there are inclined, above the Eocene strata, sandstones, marls, and exfoliated chalks of a thickness of 150—200 metres, belonging to the Miocene formation, and to which strata bearing Crustacean remains are subordinate—apparently a litoral or "fresh water facies," which is possibly later than the lower Mediterranean stage, but which is only to be regarded as Sarmatic salt- or gypsum-formation in the upper strata.

Above this lies a massive complex of strata of sandstones, marls, variegated clays, and exfoliated grey marly chalks with layers of gypsum. In Persia these strata contain oil in the lower levels.

Above the Miocene strata, in the hollows and dips, lie more recent sediments (perhaps Pliocene) diluvial clays, loess, and alluvial sands. Some 40 kilometres north-eastwards from Kerkuk, Kifi, and Chanikin a fault extends from north-west to south-east, and here a shifting of the strata is to be expected by which Eocene sediments outcrop. Here, about 15 kilometres northerly from Kasr-i-Schirin, in Persian territory, is Maidan-i-Naftun, where twelve years ago the Anglo-Persian Oil Company undertook borings which, however, did not yield favourable results, and were abandoned. From the outcrop of the Eocene this fault extends south-westerly, with outcrops of gypsum, overlaid in places with more recent formations; between Chanikin and Kasr-i-Schirin the strata are horizontal or form a slight hollow. Farther towards the south-west, however, all outcropping Miocene strata lie north-west—south-east, with a dip towards the north-east.

All petroleum found in this district occurs in the Miocene sediments, namely, in the following places: (1) About 30 kilometres north-east of Mendeli, in the Dschebel Atyech Mountains, in Persian territory. (2) About 35 kilometres north of Mendeli in the hills, to the west of the Dascht-i-Kunerig valley, and on the right bank of the Ab-i-Naft, at the village Kal'a-i-Naft. (3) About 25 kilometres north-west of Kifri, to the right of the route from Kifri to Kerkuk and Mosul, on the banks of a small river in the Palkana hills. (4) Ten kilometres farther in the same north-westerly direction, at the foot of the Naft-Dagh Mountains, on the banks of the Ak-su. (5) About 45 kilometres north of Kifri on the northerly slopes of a range of hills stretching north-west—south-east, at three villages within a range of 10 kilometres: (*a*) Gil-Schech-Dschelal, (*b*) Gil-Schech-Hamid-Koei, (*c*) Gil. (6) About 10 kilometres north-west of Kerkuk in the Baba-Gurgur Valley, at Naft-Khana. (7) On the left bank of the Tigris, towards the north-west extremity of the Dschebel Hamrin Mountains, where there is also a sulphur well. There is another sulphur spring, beyond the north-west termination of the Dschebel Hamrin, on the right bank of the Tigris in the Dschebel Makhul hills at Balalidsch, on the direct route from Bagdad to Mosul—a sign that the whole mountain range is more or less oil-bearing. (8) On the same road to Mosul, on the right bank of the Tigris, at Gaijara, at the foot of the Gaijara hills.

All these places lie along three roughly-parallel lines, extending north-west to south-east. Thus, on the first are (1), (2), and (7); on the second, (3), (4), and (8); on the third, (5) and (6). Apparently, then, there are three oil-lines; but the exact nature of the faulting, *i.e.*, whether anticlinal or otherwise, which is responsible for the outcropping of the petroliferous strata, cannot be determined without further geological investigation.

As evidence of the extent (towards the south-west) of the oil-bearing strata, it is pointed out that there is an oil-spring at the ruins of Ur, on the right bank of the Euphrates, about 20 kilometres to the west of Nasrieh and about 130 kilometres above the junction of the Euphrates and the Tigris.

W. S. N.

94 NAPHTHA FROM BALCHASCH SAPROPELS. N. D. Zelinsky. *Brennstoff-Chemie*, 1926, **7**, 33—37.

Benzine, from the decomposition of Balchasch Sapropels having a final boiling-point of 150° C., was distilled in steam. The easily volatile portion was treated with dilute and then concentrated sulphuric acid, washed, dried, and distilled over sodium (b.p. 58°—150° C.). The less volatile portion had a similar boiling range. All the fractions contained unsaturated material; nevertheless, spontaneous polymerisation did not occur. This less volatile portion was treated with 5 per cent. of concentrated sulphuric acid, washed with alkali, dried, redistilled, and added to the redistilled lighter portion. Further purification of the combined material was effected by refluxing for 30 minutes with 1 per cent. of aluminium chloride, the material (of b.p. 58°—137° C.) being then distilled from the same vessel in the presence of the reagent.

The benzine now had: $d^{11°}$ 0·717; n^{11}d 1·4071. On fractional distillation it gave the following five fractions: b.p. 50—95° C., 10·9 per cent., n^{16}d 1·3856; b.p. 95—105° C., 19·5 per cent, d ·6987, n ^{16}d 1·3991; b.p. 105—115° C., 23·9 per cent., d ·7080, n^{16}d 1·4047; b.p. 115—125° C., 29·3 per cent., d ·7184, n^{16}d 1·4099; b.p. 125°—135° C., 12 per cent., d ·7269, n^{16}d 1·4140; residue 4·3 per cent. In the specific gravity of fractions of similar boiling range, this benzine resembled the naphtha obtained by Engler (*Ber.*, 1897, **30**, 2358, **2366**; 1916, **49**, 497) by the decomposition of cod-liver oil.

After the treatment with sulphuric acid and aluminium chloride there could be but traces of unsaturated material in these fractions. Nevertheless, the fractions were all reactive towards dilute permanganate; by a gradual addition of small quantities of the reagent complete oxidation could be affected. Samples of hydrocarbon entirely indifferent towards oxidising media could only be obtained by a drastic treatment with fuming sulphuric acid (7 per cent SO^3). The oxidation of the saturated hydrocarbons proceeds only in the presence of unsaturated hydrocarbons and simultaneous with the oxidation of the latter (*cf.*, Zelinsky and Nametkin, *J. Russ. Phys-Chem. Ges.*, 1905, **37**, 959).

The portion of the 50—90° C. fraction boiling between 55 and 70° C. gave, after a treatment with fuming sulphuric acid, analytical figures corresponding with the isomeric hexanes. Fraction 95—105° C., after a similar acid wash, had a composition corresponding with that of the isomeric heptanes; the presence of methyl*cyclo*hexane in small quantity was demonstrated by the formation of pentabromtoluene by the action of bromine and aluminium bromide. Fraction 125—135° C. contained *o*-xylene, the occurrence of which was proved by bromination with the aid of aluminium bromide, the tetrabromide being produced; after the removal of the xylene by means of fuming acid, the residual hydrocarbon had a composition corresponding with a mixture of octane and nonane.

Three main fractions of light kerosene from the decomposition of the sapropels were investigated. The first, having a boiling range 140 to 240° C., gave analytical figures in agreement with the composition C_nH_{2n}. The second, of boiling range 70—195° C. at 17 mm., was treated successively with 5 per cent. alkaline permanganate, sulphuric acid (d 1·84), and fuming acid (7 per cent SO^3). The residual oil now had d^{20}_4·7747, n^{14}d 1·4372, b.p. range 180—300° C., carbon 84·78 per cent., hydrogen 14·90 per cent. The third fraction (195—250°/18 mm.), $d^{17°}$ ·820, n ^{14}d 1·4612, [α]d 0·2°, gave crystalline paraffin at the ordinary temperatures. After successive treatments with concentrated and fuming sulphuric acid, the washed and dried oil gave four fractions on redistillation at 15 mm.:—(1) b.p. 165—195° C., a liquid having [α] d+0·14. (2) b.p. 195—210° C., iridescent plates, m.p. 16° C., d^{20}_4 ·8023, n^{20} d 1·4495.

(3) b.p. 210—225° C., crystals. (4) b.p. 225—300° C., crystals, m.p. 43—45° C., which were not identical in composition with the crystals, m.p. 49—51° C., obtained by Engler and Singer (*Ber.*, 1893, **26**, 1450).

The decomposition of the sapropel kerosene by heating at 180—200° C. with aluminium chloride was investigated. From a kerosene fraction b.p. 70—195° C. at 17 mm., 46 per cent. of benzine was obtained, and 49 per cent. from a heavy kerosene of density ·86 and set-point 12° C. The yields of benzine were united and distilled, the boiling range being 13 to 155° C. The low fraction was quite saturated. The fraction b.p. 95—105° C. contained toluene; after removing the latter by means of fuming sulphuric acid, bromination in the presence of aluminium bromide gave pentabromtoluene, which shows that methyl*cyclo*hexane was also present. The fraction b.p. 115—125° C. contained 1 : 2-dimethyl*cyclo*hexane. This was proved by treating with fuming acid, and brominating the hydrocarbon with the aid of aluminium bromide; the resulting tetrabrom-*o*-xylene was, however, accompanied by liquid bromides which were washed out by means of methyl alcohol and benzene. The fraction b.p. 135—145° C. gave, on bromination, both before and after treatment with sulphuric acid (7 per cent. SO_3). tetrabrom-*p*-xylene; hence *p*-xylene and 1 : 4-dimethyl*cyclo*hexane were present. After treatment with fuming sulphuric acid, fraction b.p. 165—167° C. had a composition corresponding with the formula $C_n H_{2n}$. W. S. N.

95. Modern British Practice in Water Softening. (5) Advantages and Disadvantages of Zeolite or Base Exchange Methods of Water Softening. D. Brownlie. *Industrial Chemist*, 1926, **2**, 61-64.

Compared with the use of lime and soda-ash, the zeolite or base-exchange method of water softening offers the following advantages. Absolutely zero hardness of water is given quite irrespective of the varying quality or quantity of water, without the need for chemical control or adjustment. There is no sludge produced. The plant required is simple and compact, having no moving parts and requiring very little floor space. The process may be operated under pressure. Should zero hardness not be required it is simple to blend untreated water with the required proportion of treated water of zero hardness. Since the temporary hardness is replaced by free alkali, zeolite-treated water is superior for some purposes; *e.g.*, in laundry work or bleaching. Zero hardness water is particularly desirable in wool scouring and in the preliminary soaking of silk.

The use of zeolites, however, suffers certain disadvantages. When much temporary hardness is originally present, the alkali produced during softening will accumulate in solution in a steam boiler, with a consequent tendency to priming, with formation of alkaline steam, and the risk, if frequent blowing-down is not resorted to, of embrittlement of boiler plates. The presence of free alkali renders water softened by zeolites useless for drinking or culinary purposes; alkaline water is objectionable in dyeing or fermentation processes. Zeolites are to some extent soluble in water and hence undergo gradual disintegration. This is especially true of water containing carbon dioxide, acids, or (perhaps) iron salts. Mud or suspended solids, or oil, rapidly clogs or chokes the filter. Unlike a lime and soda-ash plant, the size of the requisite zeolite plant rapidly increases, for a given throughput, with the hardness to be removed. The absence of chemical control, apparently an advantage, may mean that, should the filter bed, having been worked harder than intended, become exhausted, unsoftened water may pass through undetected. It is said, too, that the advantage of zero hardness water for use with soap has

been exaggerated ; up to 4° hardness the calcium and magnesium soaps remain insolution, and act as detergents, hence, for this purpose, only hardness beyond 4° is objectionable. W. S. N.

96. A New Acid-Resisting Material. J. H. West. *Chemical Age*, 1925, **12**, 522.

"Prodorite" is prepared by mixing molten hard pitch with a suitable acid-resisting mineral. The pitch used must be one that remains hard at the temperature at which it is to be used. Such a substance is completely resistant to all dilute acids, to concentrated hydrochloric acid, to nitric acid up to 30%, sulphuric acid up to 70% at the ordinary temperatures, and 40% at 100° C. Although it is more brittle than cement concrete, it has practically the same tensile and compressive strengths. S. F. B.

97. An Attempt to Remove Paraffin from Grosny Petroleum on a Factory Scale. I. I. Jelin. *Neftjanoe i slancevoe. Chozjajstvo.* **6**, 462–6.

Masout was distilled to give a 70% distillate which when cold was filtered through a filter press, leaving a mass containing 50% paraffin. The filtrate was mixed with the residue from the distillate to give a type of masout having a low melting point and a low paraffin content. The process is uneconomical, as the paraffin obtained is impure. S. F. B.

98. The Problem of the Hardening of Products containing Paraffin. L. Gurvich. *Neftjanoe i slancevoe Chozjajstvo.* 7, 350—351.

It is unnecessary to assume that the hardening of paraffin solution in petroleum is due to adsorption of the liquid by crystals of the paraffin. The usual conception of a network of paraffin crystals with entrained viscous oil explains all the necessary facts. S. F. B.

99. Carborundum Furnace Assumes Uniform Heat Application in Oil Refining. Arthur E. Nash. *Oil Trade*, Feb. 26, p. 49.

The customary difficulties and dangers of local overheating concommitant with direct oil or gas firing of stills is stated to have been overcome by employing a combustion chamber composed of a carborundum muffle before the hot combustion gases come in contact with the still or pipes. Large excesses of air are unnecessary with such practice, with a consequent reduction in loss of heat in flue gases. A major portion of the heat transmission is obtained by radiation effects from the walls of the muffle, whereas, combustion being already complete, subsequent heating by connection does not produce local overheating. Tests over protracted periods using such an arrangement with a fuel oil of 18,600 B.T.U. calorific value gave 14 per cent. CO_2 in the waste gases, the temperature of which in the stack was 650° F., representing a general efficiency of 76½ %, less approximately 10% for radiation losses, etc. of the plant. A. W. G.

100. Properties of Typical Crude Oils from the Producing Fields of the Western Hemisphere. *Technical Paper* 346. U.S. Bureau of Mines, Washington.

This publication is a compilation of the more important chemical and physical characteristics of crudes produced in Canada, Mexico, Trinidad, Venezuela, Argentina, Columbia and Peru. For comparison purposes the analyses of typical crudes from the chief producing districts of the United States are also given. Considered broadly the Canadian oils have a high gasoline and low sulphur content. The Mexican oils are divided into two

classes according to the geographical position of the fields and known as Northern heavy oil and Southern light oil. These asphaltic crudes are all highly sulphurous. Trinidad oils show variation between different fields with sulphur ranging from ·3 per cent. to 2·6 and gasoline from 11 to 50 per cent. Although the Argentina oils are similar chemically, two samples show considerably less volatile components than the other two.

Two samples each from Venezuela, Columbia and Peru are tabulated, one from Peru showing a sulphur content of ·02 per cent. and containing 43 per cent. of gasoline.

S. B.

101. Oil as a Heat Transmitter at High Temperatures.—J. A. Reavell. *Oil News*, 1926, **19**, 166-167.

By heat transmission is meant the transmission of heat from the point of generation to the point where the heat is to be used. For this purpose hot oil is claimed to be preferable to steam. Thus an oil may be employed from which even at 600° F. there is inappreciable loss by evaporation. Hence equal volumes of oil and superheated steam contain greatly different quantities of heat. For instance, 1 cubic foot of oil, of specific heat 0·57, weighing about 45 lb. at 600° F., would lose, in cooling to 500° F., 2,570 B.T.U., whereas 1 cubic foot of steam at 100 lb. per sq. in. would evolve only 10 B.T.U. Normally it is preferable to allow only 50° F. drop in the oil; the true comparative figures would then be 1285 B.T.U. for oil and 10 B.T.U. for steam, per cubic foot, or in other words, oil would carry 128 times as much heat as an equal volume of superheated steam. Nevertheless the greater resistance offered by oil in flowing through a pipe must be taken into account—a larger volume of steam than of oil could be carried through the same pipe. For comparison, a velocity of 100 ft./sec. for steam and one of 4 ft./sec. for oil are taken as average safe figures. On this basis the pipe would carry 25 times the volume of steam as of oil, but since the oil carries 128 times as much heat as an equal volume of steam, the net result is in favour of oil in the ratio 128:25, or roughly 5:1. Otherwise expressed, a 4 in. pipe carrying oil would convey 1,610,000 B.T.U. per hour, whilst a 9 in. pipe would be required to carry the same quantity of heat with superheated steam. Even with so high a steam velocity as 150 ft./sec., the oil:-steam ratio with a given pipe is 3·5:1 (approx.). It is not considered that viscosity would prove a serious disadvantage, since this property decreases rapidly with rise of temperature; neither need trouble be experienced from carbonising or cracking if a suitable oil be chosen (a special grade of oil, "Meproline," is mentioned). The use of liquid water would neccessitate working in a closed system; at 600° F. (316° C.) the internal pressure would need to be about 1550 lb./sq. in. Since no known form of pump gland could withstand such a high working pressure, positive circulation could not be resorted to if water were used. The use of molten lead, although it could be successfully operated, has but a limited sphere of activity. Fluid heat transmission by oil has, however, been successfully applied to certain plant installations, examples of which are given

W. S. N.

102. Graphical Method for Determining Gas Temperatures in an Internal-Combustion Engine from an Indicator Diagram. R. W. Bailey. *Automobile Engineer*, 1926, **16**, No. 212, 47—48.

Referring particularly to a Diesel cycle, it is shown that a change of 100° C. in the initial temperature affects the thermal efficiency by only about 2%. Hence, in any work relating to thermal efficiency, there is justification for assuming the initial or suction temperature; a mean value of 350° C. (abso-

lute) appears a reasonable one. If AM is part of an expansion curve (pressures are ordinates, volumes abscissæ), the temperature at A being known, the following construction will give the temperature at M. Let the pressure, volume, and absolute temperature at A be p_1, v_1, and T_1, and the corresponding quantities at M, p_2, v_2, and T_2. Through A draw the ordinate AB, cutting the axis of volume (OX) in B; produce BA to a convenient point H such that BH represents the temperature at A (*i.e.*, T_1) on an arbitary scale. Through A and H draw the abscissæ HD and AC, cutting in D and C, respectively, the axis of pressure (OY). Join HO (O being the origin), cutting AC in G. Through G draw the ordinate GF; produce FG to cut HD in E. Then the rectangles OCAB and ODEF about the diagonal OH are equal in area, *i.e.*, OC × OB = OF × OD. But OC × OB = $p_1 \times v_1$ and OF × OD = OF × T_1. Hence, to appropriate scales, p_1, = OF × T_1 (where OF depends on the arbitrary scale, according to which BH represents T_1). But for a given mass of gas the characteristic equation requires that OF should be constant. If, therefore, OF is made constant, a repetition at any other point of the expansion curve of the essential construction, will give the temperature there, to the arbitrary scale on which BH = T_1. Thus at M: through M draw MK parallel to OX, cutting FGE in K. Join OK and produce to cut, at J, the produced ordinate, LMJ, through M. Then JL represents T_2, the temperature at M, on the arbitrary temperature scale. An application of the construction to an indicator diagram of a Diesel engine is given. W. S. N.

103. Manufacture and Application of a New Mineral Absorbent (Filtrol). Anonymous. *Chem. and Met. Eng.*, 1926, **33**, 99—101.

An account, from which all essential details have been omitted (including the nature of the raw material and of the chemicals used in its treatment), of the manufacture of a new absorbent and decolorising material.

W. S. N.

104. Chemical Composition of Rumanian Petroleum. N. Dănăilă *Petroleum Zeitschrift.*, 1926, **6**, 209—210.

The author gives data relating to the following fractions from the petroleum of Arbanasi (Buzau): (1) B.p. 65-150° C.; (2) 65-95° C.; (3) 95-125° C.; (4) 125-150° C. The volume-% on the crude oil are, respectively, 11·31, 3·41, 4·99, and 2·91. Densities, at 15° C., are 0·7542, 0·7294, 0·7594, and 0·7728. Refractive indices at 20° C. are 1·4223, 1·4092, 1·4252, and 1·4331. The volume-% averages of unsaturated hydrocarbons are 1·46, 1·65, 1·39, and 1·22; of aromatic hydrocarbons, 20·42, 17·50, 20·92, and 23·98; and of saturated hydrocarbons, 78·12, 80·85, 77·69, and 74·80. For the fraction of b.p. 150°-300° C., the volume-%-averages of unsaturated, aromatic, and saturated hydrocarbons are 1·64, 16·89, and 81·47, respectively. W. S. N.

105. Improvements Relating to Combustion Reactions and their Utilisation. S. C. Smith. E.P. 242,681.

The inventor claims the utilisation of the heat evolved by chemical combination of substances other than ordinary carbonaceous fuels, one or more of such substances being gaseous, by causing combination to occur in a combustion chamber or burner, the outlet nozzle of which is immersed in a liquid or suspension, and through which nozzle the combustion products issue into the liquid carrying with them practically the whole heat of combustion; also the use of this method in such cases that the combustion products are required to react with the liquid or suspension. W. S. N.

106. Equilibrium Boiling Points.—W. A. Whatmough. *Ind. Eng. Chem.* 1926, **18**, 43-45.

To the boiler, devised in 1921 as part of the Keith-Whatmough system of dry-gas carburation a pressure equalising tube was fitted between the top of the boiler and its float chamber. The boiler had a capacity of about 65 c.c. at normal level, and the condenser consisted of a copper coil immersed in water. The pressure equalising tube prevents variation of level during ebullition. With fuel fed at the same rate as it was vaporised constant boiling points were obtained for each fuel. To observe the equilibrium boiling point, the fuel is distilled at the rate of about 30 c.c. per min. till the boiling point is steady, and then further observations made at a constant rate of 40 c.c. and of 20 c.c. per min. The variation in boiling point should not be more than $\pm 1°$ C. The fuel assumes a spheroidal condition if the rate is increased above 45 c.c. per min. Tables show the temperature changes during distillation. Successful determinations were made with ½ to 1 litre of fuel. The equilibrium boiling point is a better index of mixture stability than the 85 per cent. point in the Engler distillation curve. The equilibrium boiling point tends towards the 85 per cent. point in paraffinoid distillates, but 70—80 per cents are usual with British motor fuels, and mixed fuels containing alcohol show a wider divergence. Irregular slope in the Engler distillation curve shows a tendency to form mixtures of minimum or maximum boiling point. Alcohol markedly depresses the equilibrium boiling point and permits low induction pipe temperatures with kerosenes.

H. M.

107. Liquid Reaction Products Obtained by the Action of Hydrogen on Paraffin Wax under High Pressure at 45° C. *Berginisation.* H. I. Waterman and A. F. H. Blaauw. *Rec. trav. chim.*, 1926, **45**, 284—295.

Rangoon-paraffin, containing 84.6 per cent. carbon and 14.8 per cent. hydrogen (400 gm.), was heated for 90 mins. at 450° C. with hydrogen; the autoclave had capacity 2000 c.c.; the initial pressure was 110 atm., during reaction 280—290 atm. (*cf.*, Waterman and Perquin, J. Inst. Petroleum Tech., 1925, **11**, 42; 1925, **11**, 374). The liquid recovered (360 gms.) was divided by fractional distillation into gasoline, f.b.p. 150° C., and a higher-boiling residue which still contained unchanged or insufficiently decomposed wax.

The gasoline was now fractionally distilled. After four distillations distinct indications were obtained of the presence of normal pentane (b.p. 38° C.), *n*-hexane(68°.7 C.), *n*-heptane (98°.4), *n*-octane (125°·1), and *n*-nonane(150°·5).

The specific gravity and refractive index of each of the corresponding 2° fractions were both somewhat higher than the constants for the pure paraffin hydrocarbons, although sufficiently close to furnish ample proof of identity. An explanation is found in the presence, in each fraction, of about 10 per cent. of the olefine having the same number of carbon atoms (thus pentene in the pentane fraction, hexene in the hexane, etc.). This figure (about 10 per cent.) was arrived at by means of the bromine number (Macilhiney). The crude recovered oil from the bomb had bromine number 11 to 13; "unsaturation" is therefore spread over all the fraction.

Traces of aromatic hydrocarbons were carefully sought. After nitration and dilution (using fractions 80—82° C. and 68—69° C.) the odour of nitrobenzene was not apparent. The reaction product was reduced and tested with calcium hypochlorite solution; there was no violet colouration. An artificial mixture of hexane with 0.25 per cent. benzene gave both reactions; it is therefore practically certain that benzene was absent from the fractions

investigated. Fraction 110—112° C. was nitrated and reduced, and the product diazotised and treated with Schäffer salt. A slight colouration was produced of about the same intensity as from an artificial mixture of hexane containing 0.25 per cent. toluene. A trace, but only a trace, of toluene may be present.

The conclusion is drawn that the gasoline-fractions obtaining on "bergin-ising" paraffin wax under the conditions mentioned contain large quantities of homologous paraffin hydrocarbons, and probably about 10 per cent. of homologous olefines. Benzene and toluene are absent, or are present in extremely small quantities. W. S. N.

108. Progressive Halogenation of Saturated Open-Chain Hydrocarbons. H. Gault. *Les Matières Grasses*, 1926, **214**, 7427-7428.

A discussion of some of the theories relating to the process mentioned, with and without the aid of catalysts, is given. W. S. N.

109. Hydrogen for Hydrogenation of Oils. A. E. Knowles. *Chem. and Ind.*, 1926, **45**, 121—122 (to be continued).

Of the various processes for the manufacture of hydrogen for the hydrogenation of oils, only the electrolytic decomposition of water has survived The Haber-Bosch process (interaction of water-gas and superheated steam in presence of a catalyst) is the cheapest large-scale process. But the hydrogen remaining after the removal of carbon dioxide by absorption in cold water always contains a large percentage of nitrogen, and is therefore unsuitable. The Lane steam-iron process, though once much used, suffered from the disadvantage that traces of carbon monoxide and sulphur compounds in the hydrogen produced affected the speed of hydrogenation. The Linde process (separation of hydrogen from water-gas by liquefaction) is believed now to have been abandoned; the initial cost of plant is high, and it is difficult to remove the last of the carbon monoxide. The oxygen produced as by-product in the manufacture of electrolytic hydrogen is usually a valuable asset; the proceeds from the sale of compressed oxygen may actually cover the entire cost of running the hydrogen-producing plan. Moreover the cost of cells at any particular voltage is practically in direct proportion to the output.

In recent plants the gases are washed by the automatically-controlled feed of distilled water, the consumption of which averages about 10 per cent. above the theoretical. For the purification of the gases, Siemens-Schuckert used a silver tube containing palladium-pumice heated electrically; considerable amounts of electricity were used and the tubes frequently burnt out. Knowles preheats the incoming gas by the outgoing gas, the catalyst being spread over a large area. Artificial heating is only required at starting. Garuti and Pompili used a perforated plate in the electrolyte to keep the gases separate; Siemens-Schuckert used short electrodes, well apart, without a diaphragm. Dr. Schmidt (Oerlikon) used asbestos sheet in a potassium carbonate electrolyte. A specially woven fine steel gauze is effective and lasting. More recently inproved woven asbestos cloth is used; this keeps the gases apart so effectively that subsequent purification is unnecessary. Moreover, the danger, with a metal diaphragm, of the latter becoming polarised and causing the generation of mixed gases on one side of the separator, is avoided. W. S. N.

110. Chemical Reactions in the "Sweetening" of the Benzines Distillates. C. Morrell and S. Grant. *Petroleum Zeitschrift*, 1926 **6**, 218—219; *cf.*, *Oil Eng. and Finance*, 1925, **401**.

"Sweetened" benzine is attainable according to the equations: $RSH+NaOH=R{\cdot}S{\cdot}Na+H_2O$; $2\ RSNa+S=R_2S_2+Na_2S$, the mercaptans

being converted to the corresponding disulphides. The reaction: $Na_2S + 2H_2O + Na_2PbO_2 = PbS + 4NaOH$, also occurs. A similar reaction takes place between mercuric oxide and mercaptans: $2\,RSH + HgO = Hg(RS)_2 + H_2O$; $(RS)_2Hg + S = HgS + R_2S_2$.

The reaction between a mercaptan and sodium hydroxide in the presence of sulphur was verified by dissolving *n*-butyl mercaptan in caustic soda solution and shaking with sulphur. An oil separated which boiled at 220°C, corresponding with *n*-butyl disulphide. Lead sulphide and lead mercaptides may be separated by means of glacial acetic acid. With increasing percentage content of the higher mercaptans, the quantity of mercaptide in the precipitate decreases. With *n*-butyl mercaptan, the precipitate contained 46·3 per cent. lead sulphide; with octyl mercaptan, 84 per cent. lead sulphide; and with cetyl mercaptan, 100 per cent. Cracked distillate from Smackover crude oil gave a precipitate containing 17 per cent. mercaptide; pressure distillate from Mexican crude oil gave a precipitate containing 15·4 per cent. By heating to 110°C. and then keeping a long time (or freezing), lead mercaptides were separated from the cracked distillates or from the pure compounds dissolved in ether (? petroleum ether); thus the solutions of lead mercaptides in oil have different stabilities. Mercaptides of higher molecular weight are the most soluble in oil. W. S. N.

111. Preparation of Hexachlorethane by the Chlorination of Ethylene. G. E. Miller. *Ind. Eng. Chem.*, 1925, **17**, 1182—1183.

The action of chlorine or natural gas in the presence of a suitable catalyst leads to the formation of chloroform, carbon tetrachloride and hexachlorethane. This last substance can be obtained in 90 per cent. yield by chlorinating ethylene between 300—350°C. using activated charcoal as catalyst. At 200° the yield is greatly reduced. The hexachlorethane obtained is in a very pure orm. S. F. B.

112. Remarks on the Theory of Adsorption and Distribution. A. Frumkin. *Z. Physik Chem.*, 1925, **116**, 501—503.

The quotient of the distribution coefficients for succeeding members of a homologous series should be constant and from experiments with alcohols in the system, cotton seed oil—water and of fatty acids in the water—benzene system, this appears to be true. Data on the distribution of fatty acids in the water—water vapour system at 100° ; as well as adsorption figures for propionic butyric acids show that work is necessary to remove a CH_2 group from the surface of the liquid into the vapour. From this it is assumed that the carbon chain is attracted to the surface and so, if there is enough space, lies parallel with it. S. F. B.

113. Synthetic Methanol. R. T. Elworthy. *Can. Chem. Met.*, 1925, **9**, 139—140.

A review of the Badische, Patart and Audibert processes for preparing methyl alcohol from water gas and hydrogen.

The Badische process consists in passing purified water gas containing 60 per cent. hydrogen and 30 per cent. carbon monoxide together with some nitrogen and carbon dioxide over a catalyst heated to 400°. The gases must be perfectly free from sulphur and volatile iron compounds. Suitable catalysts include Zinc oxide 90 per cent., chromium oxide 10 per cent.: Zinc oxide 85 per cent., vanadium oxide 15 per cent.; or cadmium oxide 90 per cent., chromium oxide 10 per cent.

The Patart process employs water gas and hydrogen at pressures between 150 and 250 atmospheres and a catalyst containing copper oxide 90 per cent. and Zinc oxide 10 per cent. heated to 400—420°.

In the Audibert process catalysts containing the suboxides of manganese, lead, tungsten, bismuth and vanadium are employed.

The running costs of the three processes are compared. S. F. B.

114. Commercial Manufacture of Synthetic Alcohol. F. Valette. Chimie et Industrie. 1925, **13**, 718—221.

The process described is shortly to be used at the Béthune mines for the manufacture of alcohol from the ethylene present in the coke oven gases. The gas is first cooled in such a manner that the various constituents, *e.g.*, benzene, methane, ethylene, carbon monoxide and so on, are obtained separately, only hydrogen is left which will be used for the preparation of ammonia by the Claude process. The ethylene is absorbed continuously in violently agitated sulphuric acid at 40—50°C. which contains about 18 per cent. of ethylene. The solution of ethyl hydrogen sulphate so obtained is then fed into a fractionating column where it meets a stream of ammonia in a counter current direction. As a result, the temperature rises considerably, saponification of the acid sulphate occurs, alcohol distils off and ammonium sulphate is obtained as a by-product. A crude alcohol of 30—60 per cent. can be obtained by this process. S. F. B.

115. Practical Substitute Fuels, particularly Synthetic Fuels. A. Grebel. *Chaleur et Industrie*, 1925, **6**, 226—229.

After carefully considering the problem the author concludes that in order to be a suitable gasoline substitute, a fuel must fulfil the following conditions: the hydrogen content must be between 7—16 per cent. and the oxygen less than 25 per cent.; the flash point as little below 20° as possible; calorific value 7000 cals. per litre and the calorific value of a perfect explosive mixture at least 750 cals. per litre. The price also must be lower than that of gasoline. S. F. B.

116. Fuel Oil. Specifications for American Fuel Oils A, B, and C, for use in the French Navy. E. Davin. *Matieres Grasses*, 1926, pp. 7432—7434.

The fuel oils must have a specific gravity not less than ·890 at 15°C., and must be liquid at 0°C. There must be no acidity. Flash-point not lower than 80°C.; viscosity at 35°C. not greater than 15°E. Sulphur not greater than 2·5 per cent.; calorific value not less than 10,500 cals. Water and sediment (by centrifugation) not more than 1 per cent.; water (distillation with xylene) not more than 0·7 per cent. W. S. N.

117. Fuel Oil Combustion. W. F. Ravener. U.S.P. 1,542,171.

The unvaporised oil particles are forced on to the surface of a liquid having a boiling point higher than the flame temperature. A suitable material is molten lead, the surface of which may be covered with iron filings which act as a powerful catalyst in the combustion. S. F. B.

118. Liquid Motor Fuel. H. B. Hutchinson and Distillers Co., Ltd. E.P. 232,276.

A stable alcohol-gasoline fuel is obtained by distilling a mixture of alcohol and gasoline until most of the contained water has distilled over. After standing for some time the portion of the distillate, consisting mainly of alcohol and hydrocarbon, is added to that remaining in the still. S. F. B.

119. A Note on the Estimation of Unburnt Carbon from the Analysis of Flue Gases. By R. W. Chapman. *Fuel*, Vol. V., No. 3, p. 128.

A criticism of the statement made by Kreisinger (*Ind. & Eng. Chem.*, Dec. 1925, 17.12.1232). that the analysis of furnace gases gives information only as to the amount of excess air used in combustion and does not indicate the amount of unburned carbon in the flue dust. It is shewn that analysis of the flue gases gives data from which the quantity of unburned carbon may be calculated, the ultimate composition of the original fuel being known.
A. W.-G.

120. Carbon Black produced from Natural Gas in 1924. G. B. Richardson. *Mineral Resources of the United States*, 1924, Part II, pp. 121—125. Published Nov. 2, 1925.

The production of carbon black by plants operating in various counties in the United States is given together with values, quantities of gas used and yields. A total of 46 producers operating 69 plants in 9 States produced 186,872,034 pounds—an increase of 35 per cent. over the production in 1923 and nearly three times the output of 1922. Stocks held in the custody of producers amounted to 95,671,246 pounds, this degree of over-production leading to the extraordinarily low average price of 6.2 cents per pound received by producers. The total value of carbon black produced in 1924 was 11,564,936 dollars at the plants. Louisiana continues to lead all the States in production of carbon black by producing 77 per cent. of the total output of the country. In this year, almost 75 per cent. of the gas used for carbon black production had been previously stripped for natural gas gasolene. The average yield of carbon black is reported as being only 1·2 pounds per 1000 cubic feet of gas treated.
A. W.-G.

121. Paraffin Oil as a Washing Agent in the Recovery of Benzene from Gas. K. Stumpf. *Gas v. Wasserfach*, 1924, **67**, 515—517.

Paraffin oil b.p. 280—400°, density 0·93 and hardening point —4° has been found to be a very suitable substance for the recovery of benzene from gas.
S. F. B.

122. Permanent Charcoal Plant installed for Natural Gas. R. Munsell. *The Refiner and Natural Gasoline Manufacturer*. Feb. 26. p. 19.

The Skelly Oil Company, as a result of successful operations at Stroud. have adopted the use of charcoal extraction of natural gasoline from natural gas at Davenport, Lincoln County, Oklahoma. The plant, of which a short description is given, consists of scrubber, three 7 feet by 30 feet charcoal absorbers in parallel and the necessary steam raising, water separating, and condensing equipment.
A. W.-G.

123. The Reduction of Carbon Monoxide to Methane in the presence of Various Metals. F. Fischer, H. Tropsch and P. Dilthey. *Brennstoff Chemie*, 1925, **6**, 265—271.

The ability of a number of metals, prepared where possible by the reduction of their oxides at low temperatures, with and without the addition of alumina to reduce carbon monoxide and hydrogen mixtures, was tested at temperatures between 100—800°C. Ruthenium at 300° gave the best results, 34·4 per cent. of methane being produced from a mixture of carbon monoxide and hydrogen in the proportion of one part to five parts. Alumina proved a useful carrier particularly with iron. The least active metal tried was silver.
S. F. B.

124. Activated Carbon and Silica Gel for Recovering Benzene from Gas. E. Urbain. *Gas J.*, 1924, **167**, 449.

A comparison of the advantages of silica gel and activated carbon, with particular reference to the latter, for the recovery of benzene from gas. Heat can be saved in removing the benzene from activated charcoal by using external heating at first, steam only being admitted when the temperature reaches 100°. Besides benzene, cyanogen and naphthalene derivatives are also removed from the gas. Such benzene conforms without further treatment to the specification for a motor fuel.

S. F. B.

125. The Absorption of Gases and Vapours by Liquids. J. Brown. *J.C.S.I.*, 1925, **44**, 410-412T

Working on the fundamental principle of gas washing for the recovery of a substance from a gas or a vapour, that is, that the solvent can absorb the substance until the vapour pressure exerted by it in solution is equal to its partial pressure in the original gases, the author has deduced an equation expressing the laws governing the absorption of solution of gases in liquids.

S. F. B.

126. Improvements in Processes for the Recovery of Readily Liquefiable Constituents from Hydrocarbon Gas Mixtures. E. C. R. Marks (Carbide and Carbon Chemicals Corporation). E.P. 245,860.

The inventor claims the process of recovering gasoline from natural gas and rectifying the same, to remove excessively volatile constituents, *e.g.*, propane, at a pressure less than atmospheric, whereby evaporation of the gasoline after removal from the rectifying plant is retarded; also, the same process, the gasoline being transferred, immediately after rectification, to a heat-insulated container.

W. S. N

127. Improvements in the Separation of Vapourised Organic Substances from Gaseous Mixtures. J. J. V. Armstrong (N.V. Algemeene-Chemische Productenhandel). E.P. 245,856.

The separation is accomplished by adsorption of the required constituent by means of a suitable adsorbent. The inventor claims (1) a container for the adsorbent, with a series of coils to receive heating or cooling bodies, so disposed within the container that they are situated within the body of the adsorbent; (2) a container in which the coils occupy 8 per cent. to 12 per cent. of the total volume; (3) a container, with coils, which is sealed so that it may be evacuated.

The coils may be (*a*) helical, (*b*) in zig-zag formation.

The coils are arranged in a plurality of layers.

W. S. N.

128 Recovery of Gasoline from Natural Gas. H. A. Mossor (South Penn Oil Co). U.S.P. 1,565,749.

Natural gas (from which, if necessary, part of the gasoline has already been recovered by compressing and cooling) is compressed on to naphtha of 47° to 55° Baumé gravity, the increase in gravity being limited to 1° Baumé. The naphtha is separated from the uncondensed gas; dissolved gasoline is liberated from it as vapour by reducing the pressure without the application of heat. This vapour is then mixed with fresh natural gas, if the latter is "wet," before the initial stage of compressing and cooling.

The expansive force of the stripped gas may be utilised to impel the naphtha (after removal of the dissolved gasoline) into contact with fresh unstripped gas. To prevent a fall in temperature during the release of pressure on the gasoline-naphtha mixture, heat interchange between the compressed vapours and the naphtha is utilised. W. S. N.

129. Improvements in the Separation of Liquids from Gases. W. S. Hele-Shaw and W. E. Beacham. E.P. 242,918.

The inventors claim a separator for separating liquids from gases, consisting of a vessel containing a series of vertical rods between which the gas is passed and down which the separated liquid drains, the rods being arranged between [horizontal] plates supported within the vessel so as to form a passage through which the gas passes and which is connected at one end to the gas inlet and open at the other into the vessel, so that the gases will be distributed over the whole of the series of rods before passing to the outlet for the separated gases; a perforated distributing plate may be arranged between the inlet of the vessel and the vertical rods. W. S. N.

130. Absorbing Gasoline Vapours from Natural Gas. W. G. Laird. U.S.P. 1,541,514.

The absorbent liquid, such as an oil, is used in the form of a thin horizontal layer of foam. S. F. B.

131. Process and Apparatus for the Continuous Treatment of Natural-Gas Gasoline. G. G. Oberfell, A. M. Ballard, R. C. Alden, E. L. Utsinger, and W. R. Lentz (Chestnut and Smith Corp.). U.S.P., 1,574,507.)

The inventors claim the process of treating cool natural-gas gasoline by dissolving sulphur in it and passing the gasoline through "doctor" solution. The latter is steam-heated; the warm out-going gasoline is then used, in a heat-exchange apparatus, to warm in-coming gasoline. The process is continuous; provision is made for by-passing incoming gasoline around the sulphur-absorption tower. W. S. N.

132. Recovery of Gasoline, etc. Harold B. Bernard. U.S.P. 1,560,137. November 3, 1925.

An improved method is described for the recovery of liquid hydrocarbons from natural gas. The hydrocarbons are first absorbed in the conventional manner, but improved means are provided for their separation from the absorbing medium. The charged liquid absorbent is preheated under pressure, whereby a partial separation is effected. The liquid and separated gases are then passed in counter current and in direct contact through another vessel in which the pressure is substantially lower than in the preheater. In this way it is claimed that more complete separation is effected with the result that less absorbing medium is required, and consequently great economy of heat and plant obtained. Suitable plant for working the process is described together with means for rectification of the gasoline obtained.

E. S. S.

133. Action of Petroleum Refining Agents on Naphtha Solution of Pure Organic Sulphur Compounds. A. E. Wood, Clyde Sheely and A. W. Trusty. *Ind. Eng. Chem.*, 1926, **18**, 169—171.

Previous work (cf. Wood, Lowey and Faragher, *Ind. Eng. Chem.*, 1924, **16**, 1116) on the action of refining agents on various types of sulphur compounds dissolved in sulphur-free naphtha has now been extended to include such

refining agents as sulphuric acid, sodium plumbite, sodium hydroxide, silica gel, fuller's earth and aluminium oxide. The sulphur containing compounds selected for examination included iso-amyl mercaptan, hydrogen sulphide, dimethyl sulphate, methyl *p*-toluene sulphonate, carbon disulphide, *n*-butyl sulphide, *n*-propyl disulphide, thiophen, diphenyl sulphoxide and *n*-butyl sulphone. A solution of sulphur itself was also examined.

The effect of sulphuric acid was found to vary with the strength of acid employed, although the actual amount of the reagent used made little difference. Fuming acid proved to be an excellent refining material for all but free sulphur, hydrogen sulphide and carbon disulphide the sulphur contents of solutions containing these substances remained unaltered. The acid appears to act chiefly by its solvent action but mercaptans and hydrogen sulphide are oxidised by it. Thiophen is removed as thiophen sulphonic acid, and of 66 Bé, is much less effective but is still capable of oxidising hydrogen sulphide and mercaptan; it does not possess the solvent action of the stronger acid. Still weaker acid (53 Bé) is still less effective and acts either by removing readily hydrolysable substances, such as dimethyl sulphate, or easily soluble substances. The refining action of sulphuric acid is therefore determined by the strength of the acid. Sodium hydroxide solutions were found to be without action on free sulphur, methyl *p*-toluene sulphonate, carbon disulphide, alkyl sulphides and disulphides, thiophene and both the sulphoxide and sulphone examined. Hydrogen sulphide was completely removed, but the mercaptans only partially depending on the concentration of sodium hydroxide employed; dimethyl sulphate was readily destroyed by the stronger soda, although less so by weaker solutions.

The action of sodium plumbite solution was found to be very similar to that of sodium hydroxide solutions. The alkyl sulphate was however, removed as lead sulphide, the hydrogen sulphide as lead sulphide and *iso*-amyl mercaptan partly in the form of the lead mercaphide. In the last example, addition of sulphur proved useless, merely increasing the sulphur content of the naphtha solution.

No previous treatment was given to the silica gel before testing its action but the fuller's earth and alumina were given heat treatments at 250° for two hours and 1000° for three hours respectively.

It was found that silica gel completely removed the alkyl sulphate, sulphoxide, and sulphone; roughly 75 per cent. of the *p*-toluene sulphonate and mercaptan was adsorbed as well as traces of the other compounds. Fuller's earth also removed the alkyl sulphate, sulphoxide and sulphone. It also slightly reduced the content of *p*-toluene sulphonate but otherwise was without effect. Alumina proved to be the least effective only slightly reducing the sulphur contents of the mercaptan and alkyl sulphate solutions. Free sulphur, thiophen, carbon disulphide and hydrogen sulphide did not appear to be affected by any of these materials. The reduction of the sulphur content, when it occurs, appears to be due solely to adsorption. The authors suggest that the "sweetening" effect of salica gel in due to the removal of the mercaptans. S. F. B.

134. Bleaching Problems. H. Wenge. *Wochbl. Papierfab*, 1925, **56**, 1925.

The Chemical Works of the Greisheim-Elektron has recently introduced on the market, a caustic soda bleach (25° Bé) containing 150—160 gms. per litre of active chlorine and also a calcium hypochlorite ("Perchloron") completely soluble in water. S. F. B.

135. Process of Refining and Decolourising Bitumens. E. G. Acheson. U.S.P., 1,574,742.

The inventor claims the treatment of hydrocarbon materials (petroleum or shale, crude oil, residues, or distillates) by two steps comprising: (1) mixture with sulphuric acid together with a precipitated clay, preferably roasted at 550° C., followed by settling and separation of the refined hydrocarbon; (2) decolourisation of the practically neutral hydrocarbon by agitation with an anhydrous oxide, preferably magnesium oxide, the latter being advantageously blended with precipitated (reflocculated) clay which has been roasted at (preferably) 650° C. W. S. N.

136. Improvements in or Relating to the Purification of Benzol and Similar Hydrocarbons. K. Cox and P. J. McDermott. E.P., 246,210, 1926.

Benzol, petrol and the like light distillates are freed from gum-forming constituents by adding to them finely powdered micro-porous natural earths or clays, *e.g.*, bauxite, kaolin, soapstone, etc., and distilling the mixture with, or without, agitation. H. G. S.

137. Treatment of Low-boiling Hydrocarbons, W. F. Downs. U.S.P. 1,568,812.

A vapour-phase method for treating vapours of hydrocarbon liquids, of boiling point not greater than 500° F., containing unsaturated hydrocarbons, with anhydrous aluminium chloride; other metallic chlorides may be used, and the chloride is preferably admixed with an inert body, *e.g.*, a mixture of silica and graphite. The peculiar feature claimed is that the metallic chloride is so supported that the condensate is formed in contact with it, but draws away from it, as soon as formed. Thus the process may be conducted in an apparatus comprising a vessel having three superimposed compartments; connection between the uppermost and lowest compartments is provided by a plurality of vertical cylindrical containers within which the chloride is supported on perforated plates; the vapours to be treated are led into the top compartment, and in contact with the chloride in the vertical members they are condensed; the condensate passes through suitable openings in the lower end of the vertical members, to the lowest compartment, from which it is withdrawn; through the space about the vertical containers, formed by the middle compartment, there is circulated a cooling medium, the temperature being maintained at some convenient temperature below the volatisation temperature of the chloride or of its compounds, and below the boiling point of the hydrocarbon being treated. W. S. N.

138. Purifying Hydrocarbon Liquids. W. F. Downs. U.S.P. 1,568,813 (*cf.* W. F. Downs, U.S.P. 1,568,812).

The inventor claims the process of purifying a hydrocarbon liquid by passing the same, at a rate of flow which may be varied (if necessary, during any one operation) according to the activity of the filtering medium, through a heated filter bed containing aluminium chloride (or other metallic chloride), which chloride may contain an inert substance, *e.g.*, silica or graphite, or both, the filter bed being maintained at a temperature below the volatilising temperature of the chloride and below the boiling point of the liquid. The inventor also claims heating the filter bed to reduce the viscosity of the liquid, but not to vaporise it. This invention appears to differ from the preceding one (U.S.P. 1,568,812) only in that the hydrocarbon is already in the liquid state when brought in contact with the metallic chloride.

W. S. N.

139. Refining Hydrocarbon Oils. S. P. Coblentz and S. P. Coleman. U.S.P. 1,540,929.

The oil is treated with acid of 66° Bé and after removal of the sludge, is emulsified with a salt solution. The emulsion is destroyed by electrical treatment. S. F. B.

140. Improvements in and Relating to the Treatment of Liquids, Gases or Solutions with Active Carbon. H. E. Potts (Naamloose Vennootschaap Algemeene Norit Maatschappij). E.P. 245,912.

The inventor claims the use, for treating liquids or gases, of carbon having the following characteristics: An organised structure derived from the vegetable raw material used in its manufacture; a specific gravity determined in ether of not less than 2·0; an apparent specific gravity of not more than 0·1; a heat of adsorption for benzene of more than 40 cals. per gram; a content of elemental carbon (calculated free of moisture and ash) of not less than 97%; a moisture adsorptive capacity, at ordinary temperatures in an atmosphere of relative humidity 60, of not less than 20%; and an iodine adsorptive capacity whereby more than 80% of the iodine in 50 c.c. decinormal iodine solution is absorbed by 0·5 g. of the carbon.

Processes for the production of such carbon are described in co-pending applications; an example of a method is, however, given, by which it is stated that carbon is formed having 3 to 5 times the adsorptive power of "Norit" carbon. Crude oil, air, superheated steam and dry-distilled pine wood charcoal are fed into a retort under the following conditions: Oil at such a rate that a temperature of 1000°—1200° C. is produced in the activating zone; air sufficient for combustion of the oil; steam such as will pass an aperture 2 mm. diameter at 2—3 atms.; charcoal in granules 2—3 mm. diameter at 10 kg. per hour; the time during which carbonaceous material remains in the activating zone being regulated by applying a suction draught of 6 mm. water.

As examples, the carbon is used for decolourising sugar solutions, wine, linseed oil; as carrier for a nickel catalyst in hydrogenation of oils; as catalyst for the decomposition of hydrogen sulphide; and for removing benzene from illuminating gas. W. S. N.

141. Aluminium Chloride. F. W. Hall. U.S.P. 1,549,766.

Acid sludge is heated until liquid, powdered aluminium ore, such as bauxite added so that it remains suspended in the acid and the whole then coked. The residue is chlorinated to produce aluminium chloride. S. F. B.

142. Preliminary Experiments on the Electro-Osmotic Dehydration of Tar. C. Mazzetti. *Ann Chim. applicata*, 1924, **14**, 379-381.

Laboratory experiments have shown that it may be possible to devise an efficient and economical electro-osmotic method for dehydrating tars. It has been shown that when the tar to be dehydrated is placed in a porous vessel together with an anode and the whole placed in a beaker of water containing a copper cathode, the water migrates to the cathode. The water eliminated from the tar was found to be proportional to the time and inversely proportional to the viscosity of the tar. Thus at 45—50° the tar was almost completely dehydrated in 12 hours, the energy consumption being roughly the same as that which would be required in centrifugal separation.

S. F. B.

143. Centrifuging Petroleum-refinery Emulsions. E. E. Ayres. *Jnr. Trans. Am. Inst. Mining Met. Eng.*, 1924, **70**, 1122-1130.

When the inorganic matter present in the "bottom settlings" is less than 2 per cent., it is best centrifuged directly, otherwise it is agitated with a solution of sodium hydroxide, carbonate or silicate, warmed and then settled before centrifugal treatment. The present author has found that resin soap which is soluble in oil, is the most effective reagent, although in aqueous solution it is no better than any other soap. The solubility of the soap in the oil ensures that each drop of water in the oil is reached by the soap; at the end of the separation it is found chiefly in the separated water. Other substances which have proved of use are starch and glue in aqueous solution; their action is considerably increased by the addition of a little caustic soda.

S. F. B.

144. Continuous Process of Demulsifying Mineral Oils. W. D. Leeper (American Demulsifying Co.). U.S.P. 1,573,321.

Oil is passed continuously into hot water contained in a suitable vessel, whereby solid impurities are precipitated whilst the oil forms a pool above the water. Open steam is passed into the pool of oil. The oil overflows into a second receptacle in which it is maintained in a heated condition by means of a closed steam coil; dehydration of the oil occurs. The oil is continuously withdrawn from this second vessel and is then used further, or, preferably, cooled in a third vessel which is provided with a cooling coil. Provision is made for the intermittent withdrawal of water from the bottom of each vessel. This process, substantially as described, is claimed as a method for continuously de-emulsifying mineral oils.

W. S. N.

145. Process of Treating (Refining) Petroleum. C. G. Hinrichs, U.S.P. 1,566,009, 1925. Appl. 3.11.23.

Emulsified crude oils are treated with an aqueous solution of ammonium, calcium or potassium sulphocyanide, preferably rendered acid by means of phosphoric or hydrochloric acid. The method is particularly applicable to those emulsions which contain mineral salts.

H. G. S.

146. Treating Emulsions of Oil and Water. W. O. Eddy. U.S.P. 1,529,349.

Petroleum emulsions consisting of oil and water, *e.g.*, natural petroleum emulsions, are treated with some substance capable of changing the interfacial tension of the constituents of the emulsions, and then subjected to the action of an electrical field to coalesce the water globules. Suitable substances include sodium, calcium or magnesium, oleates, phenol, ammonia or sodium resinate.

S. F. B.

147. Distillation and Rectification. L. Gay. *Chimie et Industrie*, 1926, **15**, 3—13 and 173—183.

A theoretical discussion of the separation, by distillation, of the pure constituents of a quaternary mixture of liquids. The mixture is supposed to be an ideal solution. It is also assumed that the order of volatility of the constituents does not change on admixture, and that perfect columns are available. Hence it is possible, by the use of one column, to separate either one constituent in a pure state, or a binary mixture free from the other two constituents. The complete separation of the four constituents therefore

necessitates the use of three columns (more generally, for " n " constituents, " n—1 " columns are needed), and this may be carried out in any one of five ways, A, B, C, D, or E. Thus, with liquids a, b, c, d : (A) Column (1), [d liquid], a, b, and c vapour ; (2) [c], a and b ; (3) [b], a. (B) (1) [d] a, b, and c ; (2) [b and c] a ; (3) [c] b. (C) (1) [b, c, d], a ; (2) [d], b and c ; (3) [c] b. (D) (1) [b, c, d] a ; (2) [c, d] b ; (3) [d] c. E (1) [c, d] a and b ; (2) [b] a ; (2_1) [d] c. An attempt is then made to treat these various methods of separation quantitatively. W. S. N.

148. Treatment of Hydrocarbons. C. N. Forrest and H. P. Hayden (Barber Asphalt Co.). U.S.P. 1,568,018.

This patent describes a continuous process for destructively distilling such solid or semi-fluid materials as heavy petroleum residues, bitumen, natural asphalt, etc., with production of gasoline, fuel oil, or even heavier oils, and simultaneously fuel gas, ammonia, cyamides, etc. The " hydrocarbon," previously fused if necessary, is incorporated with an inert, non-fusible carrier, *e.g.*, broken fire-brick, pumice, carborundum, or ash. This " fuel " is then fed continuously through a trap, to prevent escape of gas, into a gas producer (provided with the usual accessories), the base of which is surrounded by a water-seal, and which is provided with a take-off at the top for vapours and gas, and a blast pipe at the bottom through which a limited supply of the combustion agent (*e.g.*, a preheated mixture of air and steam) is introduced. The oxygen in the combustion agent is completely used up in the lowest and hottest zone (2000°F. and upwards). The fuel entering the top zone (700°—1000°F.) cracks to a rich non-condensable gas, a thin oil (condensable but in the vapour state), and soft coke. The two former are swept out by the gases rising from the lower part of the bed. The coke descends through the middle zone (1000—1900°F.), in which exhaustive cracking occurs, to the lowest zone, where the dry coke undergoes complete combustion, the carbon dioxide rising from this lowest zone being reduced to carbon monoxide in the middle zone. Nitrogen is evolved as ammonia at all stages but especially during the final combustion. The gas-vapour mixture is drawn off through a combined separator and heat exchanger, in which any very heavy oil is deposited, and in which the air-steam combustion agent is preheated. The gas-vapour mixture is then washed successively once with dilute sulphuric acid (to remove ammonia) and twice with water ; the second water wash is accomplished in the upper portion of an absorption tower, the water passing through a water-seal into the lower portion where it is used to moisten the air passing to the heat exchanger. Finally the gas-vapour mixture is passed through an oil-scrubber, from which fuel gas emerges. Condensable or liquefiable oily products are recovered from the oil scrubber and from the first water-scrubber. The producer is started up by means of a wood and coal fire, a bed of ashes 4 in. to 6 in. thick covered by a bed of burning coal being built up before the " fuel " is introduced. The " burnt " carrier emerging through the water-seal at the base of the producer is used again.

The inventors claim the continuous process of destructively distilling and gasifying hydrocarbon materials charged on an inert carrier, in such a way that the final stage (combustion) furnishes the heat necessary for the first stage (cracking or destructive distillation). W. S. N.

149. Apparatus for Separating Hydrocarbons. By Willard C. Averill, jr. U.S.P. 1,573,025.

Crude petroleum or like oil is introduced into a still through a pipe coil immersed in the hot contents of the still and sprayed into pans in the vapour space : steam produced from water in the oil atomises the oil and enhances

evaporation. The oil vapour is led to two dephlegmators in series, packed with inert material and fitted with automatic water run-offs at their bases. Heavy condensates are circulated and sprayed from the top of the first dephlegmator thus improving fractionation. An enhanced gasoline yield of 50 per cent. is claimed to be obtained by this means. Water at a known temperature may be similarly sprayed from the top of the second dephlegmator. Spirit vapours are taken from the top of the second dephlegmator to a condensor while heavy ends from the two dephlegmators are returned through the vapour line to the stills. A. W.-G.

150. Gilsonite Products. Charles N. Forrest. U.S.P. 1,573,765.

Gilsonite is distilled in a suitable form of still and the vaporised products are condensed when various oils with large quantities of wax are obtained. A. W.-G.

151. Process of Heating Fluids. F. E. Wellman. U.S.P. 1,573,591, 1926.

Fluids are heated and distilled by causing a current of heated sand or other granular refractory material to flow over and about, but not in contact with, the fluid. H. G. S.

152. Process and Apparatus for Fractional Condensation. John E. Bell. U.S.P. 1,573,129.

A closed circuit in which the evolving medium, with addition of fresh cold cooling medium to maintain its temperature at the desired point, is passed through pipes running through the body of the vapours to be condensed. The different cuts are moved so as to fall as cascades through the vapour, maintained at desired temperatures in compartments of the apparatus by means of the cooling medium, so that better fractionation is obtained. A. W.-G.

153. Apparatus for Production of Gasoline. F. Tinker. U.S.P. 1,572,626.

The inventor claims: In apparatus for the production of gasoline and like motor spirits by distillation processes, the combination with a fractionating column, of a condenser, means for conducting vapour from the fractionating column to the condenser, a collecting tank, means for conducting condensed liquid, gas, and vapour from the condenser to the collecting tank, a washer, means for passing vapour and gas from the collecting tank to the washer, a cooler, means for passing condensate from the fractionating column to the cooler, means for conveying cooled condensate from the cooler to the washer, and means for returning liquid from the washer to the fractionating column.

The process as actually described is as follows: Vapour from a still (etc.) is led to a column. The condensate is cooled and pumped through a sprayer in the top of a washer. The vapour from the column is condensed and the condensate, vapour and gas passed to a collecting tank. Vapour and gas are passed from this tank to the washer. Liquid collecting at the bottom of the washer is pumped back to the top of the column. Uncondensed gas is taken from the top of the washer, condensate from the bottom of the collecting tank. W. S. N.

154. Process of Distilling and Blending Hydrocarbons. U.S.P. 1,567,457. Apparatus for Distilling and Blending Hydrocarbons. U.S.P. 1,567,458. D.L. Newton.

A continuous process for distilling, in particular, kerosene or similar absorbent containing casing-head gasoline, whereby the gasoline is completely removed from the residue and then blended with part of the kerosene.

In Pat. 1,567,457 the inventor claims the process of preheating the mixture and spraying it into a heated chamber whereby partial vapourisation occurs; the residue is conducted successively through a series of heated chambers; the vapour, with or without the addition of live steam, is conducted through the same series of chambers in the reverse direction; in each chamber intimate contact between liquid and vapour is brought about (see below); the more volatile hydrocarbons are distilled off and blended, and a fraction of the absorbent medium is incorporated as a permanent constituent.

The apparatus for effecting this process is claimed in Pat. 1,567,458. A vertical cylindrical shell is provided with six horizontal partitions, forming seven compartments. The uppermost of these compartments has a false bottom. The five lowest partitions have a series of perforations communicating upwards with short cylindrical jet tubes open at the top and having perforations in the base just above the partitions. Between the jets in each partition are baffle plates and a steam coil. The spaces below and above the false bottom in the uppermost chamber are connected by two or more spraying nozzles. A steam coil is also disposed above and in contact with this false bottom. There are, therefore, six steam coils; these are fed from a common header into a common steam trap. The mixture to be distilled is fed into the space between the true and false bottoms of the upper chamber; from this space it issues from the spraying nozzles partly vapourised. The unvapourised residue passes by means of an external overflow pipe (fixed below the level of the nozzles) into the next lowest compartment; thence by an internal overflow pipe (fixed below the level of the baffle plates) to the next lowest, and so on until it reaches the compartment second from the bottom, whence it is withdrawn. The vapour from the top compartment is brought to the lowest, live steam being introduced through a jet in the pipe immediately before the re-entrance to the fractionating tower. Steam and vapour ascend from the lowest compartment through the five lowest partitions, bubbling through the liquid which is held on each of these; vapour (and, presumably, steam) being withdrawn from the top of the sixth highest compartment. A float fluid-level control valve is introduced in the external overflow pipe to prevent vapour from passing with the liquid from the top compartment to the next lowest.

The mixture, preferably preheated to 150—400° F., is introduced at a pressure of at least 10 lb. Live steam is used at 230—250° F. The temperature of the closed steam is not stated; but about 50 per cent. of the dissolved gasoline is said to be vapourised in the uppermost chamber under the combined action of the steam coil and the spraying. W. S. N.

155. Art of Distilling Petroleum Oils. E. M. Clark (Standard Development Co.). U.S.P. 1,566,828.

The inventor claims the utilisation of the heat content of a pressure still and its setting, at the end of a distillation, by withdrawing the still fire and introducing steam or other inert gas, thus causing a renewed circulation of the hot residue, the steam (or gas) together with vapour being carried off to a dephlegmator, from which the condensate is collected.

W. S. N.

156. Oil Still. J. Primrose (Power Speciality Co.). U.S.P. 1,566,921.

This invention relates to an oil still in which oil is caused to flow through a bank of tubes relatively remote from the firing chamber (counter to the

direction of travel of the hot gases), and then through a second bank of tubes nearer to the source of heat (*e.g.*, at the top of the firing chamber), the flow of oil and of hot gases not necessarily being counter-current in this second bank of tubes. Oil and vapour issuing from the second bank of tubes are conducted to a separator. The improvement in design and use of this type of still, for which a claim is made, consists in returning, from the separator, by means of a pump, any desired or necessary proportion of the liquid oil, to a connection intermediate between the two banks of tubes, the oil thus being forced to traverse the second bank of tubes a second time.

W. S. N.

157. Evaporating Still. D. L. Newton. U.S.P. 1,567,455.

The inventor claims a still of construction and operation described below, for removing the volatile constituent from an oil, particularly for stripping an oil which has absorbed gasoline from natural gas. The still consists of a vertical cylinder, having a conical top to which is attached a vapour line. Within the still extending completely across its section, are three partitions. The lowest is relatively near the still bottom; with the latter, it forms a bottom compartment. The uppermost, relatively near the conical top, is connected with the lowest partition by means of a concentric series of vertical tubes. The latter thus form a connection between the lowest and uppermost compartments. The middle partition is traversed by the first described set of tubes. It is joined by a second series of somewhat larger tubes to the uppermost partition. Means are provided for introducing oil into the lowest compartment, open steam into the next highest, and steam into the third highest; and for withdrawing stripped oil from the second highest and waste steam from the third highest compartments. The lowest chamber is kept filled with oil, which, passing through the tubes to the highest compartment, is preheated by the steam circulating through the third compartment. In the topmost compartment the oil overflows and descends the second series of tubes, in counter current to an ascending current of open steam. Thus the oil is subjected to the heat of the steam chamber and finally to the stripping action of open steam in counter flow to it.

W. S. N.

158. Process for Series Separation of Crude Petroleum. A. R. Earl and T. W. Reeves. U.S.P. 1,567,429.

Crude oil is heated under pressure by means of open wet steam; the oil is withdrawn in the liquid form and passed to an expansion zone where vapours are given off, these being withdrawn and fractionally condensed. The liquid from the expansion zone is again heated by means of open steam, under pressure; whilst in the liquid state it is withdrawn to a second expansion zone the pressure within which is kept below atmospheric. The vapours are collected and condensed; the liquid from this second expansion chamber is heated under pressure, this time with superheated steam. Again the liquid is withdrawn, allowed to expand, and the vapour and residual liquid separated and collected. The above process is claimed, and also the following: Oil is heated and distilled in a plurality of stages. For the last stage, heating by means of superheated steam under pressure is employed. The oil is withdrawn in the liquid state and introduced into an expansion chamber in a plurality of finely divided continuous streams by which vapourisation is aided. The vapours and residue are separately withdrawn, and the former fractionally condensed.

W. S. N.

159. Improvements in and Relating to Vapour Separation and Condensation Particularly for use with Oils. Power Speciality Co. E.P. 239,208.

The inventors claim the process and apparatus for fractionally condensing vapours substantially as follows: Four vertical cylindrical air-cooled separators are arranged in cascade. The second, third, and fourth contain, at the lower part, one, two, and three coils respectively. The coil in the second separator and the top coils in the third and fourth are connected in series; condensate from the first separator passes through them. The lower coil in the third and the middle coil in the fourth separator are connected in series, and carry condensate from the second separator. Condensate from the third separator passes through the lower coil in the fourth separator. The level of the liquid outlets from separators 3, 4, and 5 is such that the coils in them are completely submerged. The four condensates (that from the fourth separator directly, the others after passage through the coils as explained) are led through coolers. Part of the condensate from separator 4 is returned to the top of 3; from 3 part of the condensate is returned to 2; from 2 part goes back to 1; condensate from separator 1 is collected entire. Vapour-oil mixture from a still is fed tangentially into the side of separator 1, impinging upon an inverted cone the opening of which is below the level of the liquid. Vapour emerging from the top of separator 1 passes to the side of separator 2, somewhat above the liquid level; vapour from 2 passes to separator 3; from 3, vapour passes to 4. Vapour from the top of separator 4 is condensed and part returned to the top of 4 to serve as reflux liquid. Claim is made for the process of fractionally condensing the vapours and using the heat in each fraction of condensate for re-boiling the next lower fraction of condensate; for combining with this process, the return of part of the condensate to the preceding separator to act as reflux liquid; and for maintaining in each of the separators, excepting the first, a sufficient level of liquid for a "re-boiler" to be immersed in it.

W. S. N.

160. Improvements Relating to the Heating of Liquids by Direct Contact with Combustion Products. S. C. Smith. E.P. 242,680.

A burner for heating liquids, the products of combustion from the burner issuing directly into the liquid to be heated. Application of this device is made by the inventor in the succeeding E.P. 242,681.

W. S. N.

161. Process of Distilling Volatile Products. L. Granger, C. Mariller, and C. Prache. U.S.P. 1,574,622.

A claim is made for the process of distilling crude mineral oil and condensing the vapours in evaporators fed with water, the latent heat of the oil vapour being used to produce steam at a temperature only slightly less than that of the vapour and at a higher pressure, the steam being used in the heating of the crude oil or for the production of power. W. S. N.

162. Method of and Apparatus for Effecting Continuous Distillation. F. M. Hess. U.S.P. 1,568,157.

An improvement upon the distillation system described in U.S. Patent 1,443,742. Fractional distillation is effected in a gravity system of superimposed stills, crude oil being introduced into the uppermost and residue withdrawn from the lowest. The heat of the latter was utilised in the original invention by means of heat interchangers connected in alternation with the stills; the heat of the vapours or distillates was used to preheat in-coming

crude oil. The heat necessary to distil the oil was derived entirely from a counter-current of superheated steam flowing out of contact with the oil passing through the stills. In the present invention this heat is supplied by (*a*) the final residue, (*b*) the vapours or distillates, and (*c*) superheated steam. The apparatus described is somewhat complex and cannot be briefly described; the claims are based on the triple source of heat for vapourisation, as stated above. W. S. N.

163. Method and Apparatus for Distilling Oil. J. M. Wadsworth, Assr. to Pierce Petroleum Corp. U.S.P. 1,572,584 of Feb. 9. Appl. of Dec. 27, 1921.

Oil is repeatedly vapourised. Fractions of similar boiling point are combined and condensed to form primary distillates of varying volatility. These are continuously separately redistilled, the residues from the lighter distillates being added in series to the heavier distillates. H. M.

164. Heat-exchange Device. H. L. Allan. U.S.P. 1,572,374.

The claims are:—1. A heat exchange device for fractionating hydrocarbons comprising a vessel having partitions to provide three superposed compartments. The upper partition consists of two tube-plates situated relatively close together. The lowermost compartment, which is provided with a hydrocarbon inlet, is connected to the space between the tube-plates by a series of vertical tubes. From the said space a second series of tubes extend, vertically, partially into the uppermost compartment, which is provided, near the bottom, with a liquid outlet, and, at the top, with a vapour outlet. Means are provided for circulating a heating-medium around the first mentioned series of tubes. 2. A device as detailed in (1) having an external overflow pipe connecting the upper part of the uppermost compartment with the liquid outlet from the bottom thereof. 3. A device as specified in (1) having condenser pipes extending upwardly from the vapour outlet. W. S. N.

165. Oil Still. J. Primrose (Power Speciality Company). U.S.P. 1,568,182.

The apparatus consists of a furnace having a vertical partition over which hot gases pass from the fire chamber on to a bank of oil-carrying tubes in the tube chamber. Beneath the bank of tubes there is a damper; the fire chamber (firing may be accomplished by any means) is provided with the usual accessories. In such a furnace there is a tendency for the top row of tubes, with which the hot gases come first into contact after passing the partition, to become overheated; this is due mainly to intense heat radiation on to this row of tubes from the roof of the furnace. Consequently, overheating may be avoided by constructing that part of the furnace roof immediately above the tube chamber of a heat-absorbing, as distinct from a heat-radiating (reflecting) material. This is accomplished by constructing this part of the furnace roof of oil tubes exposed directly to the furnace gases; these tubes are in series with those in the tube chamber (oil being preferably introduced at the bottom), and are continued across the entire furnace roof. Above the fire chamber, however, the tubes are protected by refractory blocks or bricks. The inventor claims, particularly, the use of a heat-absorbing (non-heat-radiating) surface to that part of the roof immediately above the tube chamber. W. S. N.

Analysis and Testing.

166. Measurement of Vapour Tensions of Gasoline and other Volatile Liquids. H. S. Davis. *Ind. Eng. Chem.*, 1925, **17**, 1136—1138.

The method which is particularly suitable for gasoline or other volatile liquids, consists in saturating air with the vapour from the liquid at a definite pressure, and then determining the additional pressure necessary to compress the air and vapour mixture to half its volume, in the presence of a large volume of the liquid.

The authors point out the disadvantages of the vapour pressure bomb recommended by the U.S. Bureau of Explosives for determining vapour pressures, and describe an apparatus which they have designed for such determinations free from such disadvantages. S. F. B

167. A Portable Combustion Apparatus for Detection and Measurement of Small Quantities of Petroleum Vapour. C. A. Neusbaum, P. L. DeVerter, and E. W. Dean. *Ind. Eng. Chem.*, 1926, **18**, 183—185.

The authors, as a result of experience gained in inspecting tankers, have reached the conclusion that the various methods used for testing the atmosphere of tanks are not entirely satisfactory. Three fundamental requirements must be considered when inspecting tanks. Firstly, it is not sufficient for the atmosphere of the tank alone to be safe; there must be no deposits of oil capable of generating vapour. Secondly, the maximum permissible content of petroleum vapour must be fixed, not by the lower limit of the explosive range, but by its effect on the men inhaling it. The authors have found that men are able to work in tanks for periods exceeding 30 minutes when a maximum of 0·2 per cent. of petroleum vapour, calculated as pentane, is present. They have consequently adopted this figure for inspection work. Thirdly, the time required for inspection must be as short as possible.

The apparatus employed by the authors is readily portable, and consists of a slow combustion chamber and measuring burette combined in the form of a U-tube; this tube is completely immersed in water to insure a constant temperature. The platinum wire of the combustion chamber is connected through an ammeter and a small michrome rheostat to three dry cells in series. This circuit has been adopted so that, when the wire has commenced glowing, the current passing through it may be decreased in order to prevent overheating and consequently burning out. The sample of gas is allowed to burn for three minutes and the contraction in volume noted. As the results obtained from the apparatus are purely empirical, it is necessary to calibrate the apparatus before use. Although skill is needed to operate it, the apparatus has the advantage that results may be obtained in a very short time.

S. F. B.

168. Gasoline Testing. B. F. Ruby. *Petroleum Age*, 1925, **15**, No. 6, 23.

The inconsistency of the initial boiling point of a gasoline is chiefly due to the heat of adsorption of the vapour by the cotton wool wrapped round the bulb of the thermometer. In order to overcome this difficulty, either the cotton wool must be weighed or it must be used on the outside of the neck of the distilling flask. S. F. B.

169. Motor Fuel Standards. *Petroleum Times*, 1925, **13**, 884.

A method for testing gasoline which is now employed in Germany consists in taking the average value of the boiling points of the fuel for every ten per cent. distilled. The method is believed to be of value. S. F. B.

170. A Convenient Method for Determining Gum-forming Material in Gasoline. M. B. Cooke. *Reports of Investigations, Bur. Mines, No.* 2686, 1925.

In place of the water bath generally used for the determination of gum formation, a steam-heated oven filled with an inert gas is used. It is claimed that by this means oxidation is eliminated, the time of evaporation is shortened and that, besides using dishes of materials other than glass, standard conditions may be more easily maintained. S. F. B.

171. Automatic Apparatus for Determining the Melting Point of Organic Compounds. R. B. MacMullin. *J. Amer. Chem. Soc.*, 1926, **48**, 439—442.

A modification of Dubosc's method (*Rev. prod. chim.*, 1925, **28**, 115) for determining the melting point of organic compounds and other non-conductors of electricity. A platinum sphere is first coated with the substance to be tested. It is then inserted, alongside a self-registering maximum thermometer, in a bath of mercury. The latter is heated electrically. When the substance melts electrical connection is established between the platinum sphere and the mercury bath, which form part of a bell circuit and also of the circuit of a relay. The operation of the latter breaks the heating circuit. The ringing of the bell merely warns the observer that the melting point has been recorded. Owing to temperature lag the melting points indicated are too high, but the error is usually less than 0·3°, and may be allowed for. W. S. N.

172. A Practical Aid in the Determination of Calorific Values. Heinz Keller. *Chem.-Ztg.*, 1925, **49**, 677.

In order to avoid loss in volatile fuels a special container is prepared by drawing two capillary necks on the same end of a glass tube. The tube should be 1-1½ cms. long, and ½ cm. wide. The ignition wire is drawn through the two necks so that the loop is formed inside the container, and one neck is then closed by fusion. Such a container can be made in a few minutes; it is filled by evacuation. S. F. B.

Lubricating Oil and Wax.

173. Neutralising Action of Activated Bleaching-clays on Acidified Lubricating Oils. O. Eckart. *Zeit. Angew. Chem.*, 1925, **38**, 885—887.

German clays (particularly from lower Bavaria) that have been "opened" with mineral acid have become strong competitors of bone-black and fuller's earth in the refining of oils. These clays have greater bleaching action than fuller's earth. The best of them contain when marketed about 0·036% mineral acid, calulated as hydrochloric acid. They do not, however, increase the acidity of an acid-and-alkali treated oil, even when as much as 3 per cent. by weight of clay is used at 95°C. for 10—180 minutes. The acid of an acid-treated oil is removed more slowly by these clays than by fuller's earth, but almost the same removal of acid is effected (10 mins. for fuller's earth; 45 mins. for clays). Oils decolourised by the clays in times shorter than 45 minutes darken again during 2 to 3 days; the decolourisation, after 45 minutes, is permanent. The removal of acid by the clays is effected by adsorption, whereas fuller's earth effects the removal partly by chemical action. Oils are deacidified more thoroughly by dry clay than by moist clay. The addition of 5 per cent. calcium carbonate to a clay gave a product that removed acid from oil as rapidly and thoroughly as fuller's earth. The addition of 2·5 per

cent. sodium carbonate or quicklime gave a product superior to fuller's earth. The commercial fuller's earths contained 1·7—6·5 per cent. of calcium and magnesium carbonates. W. S. N.

174. The Change of Viscosity with the Rate of Shear in a Disperse System. A. de Waele. *Kolloid-Z.*, 1925, **36**, 332—333.

Experiments made with colloidal mineral earths in viscous oils show that viscosity, as measured by a rotation viscometer, increases with the speed of rotation. S. F. B.

175. The Action of Activated Bleaching Earths on Sour Lubricating Fractions. E. Schneller. *Petroleum*, 1926, **22**, 123—127.

The caustic wash which usually follows acid refining for the purpose of neutralising the sour oil, may be dispensed with when the latter is immediately treated with bleaching earth, which also effects this neutralisation. In place of fuller's earth and Floridin, a chemically activated Bavarian bleaching earth has recently come into use. This earth has been treated with acid, and has an acid reaction. It is, however, found that this acid earth does not increase the acidity of the oil treated, but is capable of neutralising it, almost to the same extent as do Floridin and fuller's earth. This property of the chemically activated earth is due to adsorption, while in the case of fuller's earth and Floridin it is partly due to adsorption and partly to chemical action. Dry bleaching earth is much more effective than when moist, the neutralising action taking place in a shorter time. The colouring matters adsorbed by the earth may be extracted by solvents, and the earth thus regenerated. Besides adsorption, colloidal coagulation also comes into play in the decolourising process. H. M.

176. Measurement of the Effectiveness of Lubricating Oils. R. von Dallwitz-Wegner. *Z. tech. Physik*, 1925, **5**, 378—384.

The effectiveness of a lubricating oil depends on the ability of the oil to wet the surface of the metal, and this varies with different metals. It appears to increase with the ratio of the "compressive strength" of the metal to that of the lubricating oil, the latter depending on the molecular weight and volumetric modulus of elasticity of the oil. The author has devised a new apparatus for determining lubrication, to be described later. S. F. B.

177. The Breakdown Mechanism of Moist Insulating Oil. A. Gyemant. *Naturwissenschaften*, 1925, **13**, 726—727.

Small water drops emulsified in oil tend to assume an elliptical form when brought into a strong electrical field. If the field is strong enough these ellipsoids arrange themselves to form channels of water through the oil with the result that short circuiting occurs. This theory agrees with the experimental data of Friese, who found that as the moisture content decreases, the breakdown potential increases at first slowly and then much more rapidly. S. F. B.

178. Transformer Oils and Methods of Testing them. I. Musatti and A. Pichetto. *Ann. Chim. Applicata*, 1925, **15**, 238—265.

The authors discuss all the usual methods for determining the sludge formation of transformer oils and point out that none of these methods duplicate the conditions under which sludges are formed in practice. As a result the authors have carried out a series of experiments to find the relation between the chemical and physical properties of oils from various sources and

to find their tendency to oxidise. The oxidation tests were carried out by placing the oil in copper cups of certain dimensions which were then heated with free access of air in both constant temperature air ovens and oil baths for prolonged periods. After such treatment the oil was allowed to stand, diluted with petroleum ether (2 vols.), filtered, washed, and after drying at 105° weighed on a tared filter.

The filtrate was tested after removing the solvent for acidity. The sludge closely resembled that formed under normal conditions; it was soluble in chloroform, carbon tetrachloride and benzol and partly so in amyl alcohol and ethyl alcohol-ether. This sludge also contained substances similar to those originally present in mineral oils, which must have been formed under somewhat similar circumstances. As a result of their experiments the authors conclude that no relationship exists between the Iodine, bromine or formolite numbers of the oil, and its tendency to oxidise, but that the greater the amount of the oil extractable by liquid sulphur dioxide (that is, the unsaturated aromatic part) the greater is this tendency to oxidation. Sludge formation occurs at comparatively low temperatures (93°), but only after prolonged treatment (300 hrs.); as the temperature increases the tendency to form sludge increases rapidly. S. F. B.

179. Stopcock Lubrication and an Improved Lubricant. E. G. R. Ardagh and A. L. Davidson. *Can. Chem. Met.* 1925, **9**, 137.

The lubricant is prepared as follows: white petrolatum (77·5 parts) is melted with white paraffin (m.p. 53°; 15 parts) in a beaker suspended in an oil bath at 130° and pale rubber crêpe (7·5 parts) cut into shreads is slowly added. After stirring for six hours, the mass is poured, while just fluid, on to a cold, clean, aluminium plate. When cold it is scraped off and placed in boxes. This substance proves a very fine lubricant for stopcocks. It is unaffected by 15 per cent. caustic soda solution, and has no appreciable vapour pressure. S. F. B.

180. Simplified Method for Determining the Viscosity of Oils. M. W. Borodulin. *Petroleum Z.*, 1925, **21**, 445–448.

A drop of water is allowed to fall through a definite amount of oil and the time taken is noted. The time taken for oils having viscosities above 2 Engler is practically always constant at 51 seconds. Values found for three different grades of lubricating oils at various temperatures are given, together with a formula for calculating the absolute viscosities from the figures obtained. S. F. B.

181. Density of a Lubricating Oil at Temperatures from −40° to +20° C. H. K. Griffin. *Ind. Eng. Chem.*, 1925, **17**, 1157–1158.

A special form of pyknometer is employed consisting of a spherical bulb, roughly 5 cc. in capacity, blown on the end of a capillary tube having an internal bore of 2 mm. A uniform scale, arbitrarily numbered, is etched on the stem, and the volume of the bulb and the capillary accurately determined for the various graduation marks on the stem. By means of this instrument it is possible to measure the density of any liquid at a number of temperatures with only one filling, providing that the error, introduced by the film of liquid clinging to the walls of the capillary above the meniscus can be neglected. In order to minimise this error the readings at the lowest temperatures should be taken first. The readings are made after the pyknometer has been kept at the required temperature for over an hour, a low-temperature thermostat being employed for low temperatures. The instrument is filled by evacuation. S. F. B.

182. LUBRICATING OILS FOR WATTMETERS. D. Holde and R. Schachenmeier. *Petroleum Zeitschrift*, 1926, **22**, 161-168.

Wattmeters are generally designed to run with dry bearings; some, however, specifically the instruments of the A.E.G., Berlin, have a lower bearing which runs in a bath of lubricating oil. Since the accuracy of the meter depends entirely upon the proportionality between quantity of electricity passing and velocity of rotation, a high grade of oil, and particular one which will give a uniform performance, is required. The author discusses the factors governing the suitability of oils for this purpose; it is hoped, eventually, to attain a standard, of general applicability to oils for wattmeters, such as has hitherto been lacking.

A determination of the practical limits of viscosity was carried out using a 110-volt, alternating-current ampère-hour meter, maximum load 5 ampères. The meter was run dry at loads of 1 per cent. and 20 per cent. of the maximum; this was repeated with oils having viscosities at the ordinary temperature, of from 2·56° to 21·8° Engler. Times of rotation were then compared. With oils of viscosity up to 15° E. the meter ran but slightly slower than with a dry bearing; with an oil (E=21.8°) it ran markedly slower. The actual rate of running, which depends on the viscosity of the oil (amongst other factors) is immaterial, provided that subsequent to calibration there is constancy of performance. Nevertheless, from the above results a maximum viscosity of 20° E. at ordinary working temperatures is thought desirable. Moreover, it is essential that this value should remain unchanged either by gumming, partial evaporation, oxidation, or by being cooled to the lowest temperature (*e.g.* —25° C.) to which the instrument might be exposed during use. Since, with even the thinnest oil used (E28° C.=2.56°), there was no appreciable improvement when the meter was run dry a minimum limit of viscosity does not appear necessary.

Although one of four different oils in commercial use had appreciably less vapour pressure at 50° C. and 110° C., a definite maximum for the permissible volatility of a meter oil is only to be obtained by further, prolonged research. Similar remarks apply to the iodine numbers; indeed it yet remains to be seen how far iodine numbers are an indication of probable gumming. Experiments on the oxygen absorptive powers of the same oils did not lead to any practical conclusion.

Efficient lubrication necessitates a complete wetting by the oil of the bearing surfaces (a diamond-dust bullet rotating in a sapphire bed), but a too ready wetting of the material of the shaft or of the main body of the bearing, will tend towards a loss of the lubricant by creeping. The oil chosen should, therefore, have a widely different surface tension in contact with (*a*) sapphire or diamond-dust, (*b*) bearing metal or tinned steel.

W. S. N.

183. CHANGES UNDERGONE BY MINERAL OILS IN COLLOIDAL SYSTEMS. F. Evers. *Zeits. angew. Chem.*, 1925, **38**, 659-662.

It is thought that the deterioration of transformer and switch oils arises from changes occurring in the oil adsorbed in the capillaries of the materials from which the apparatus is made. The high concentrations of oxygen and water in this adsorbed oil increases the velocity of sludging by the formation of acidic substances. Analyses are given of a very old sample of used transformer oil. The part of the oil insoluble in petroleum ether contains 14.1 per cent. oxygen. Silicates remove more of the acidic substances from a used oil than silica gel; the removal is better when the silicate is used in successive portions rather than as a single portion.

W. S. N.

184. Machinery Lubricating Oils.—J. Swoboda. *Petroleum*, 1926, **22**, 247-253.

The normal amount of loss from friction in a manufacturing plant may be as much as 40 per cent., which is capable of considerable reduction by suitable lubricating or *vice versa*. The most important qualities of a lubricant are its adhesion, oiliness, or property of clinging to the lubricated surface, and its viscosity, which is a measure of its internal friction. The greater the viscosity the less the expenditure of an oil, and the less is it liable to be displaced from between the bearing surfaces, but the greater is the friction. A good oil should therefore have minimum viscosity consistent with sufficient oiliness to adhere to the rubbing surfaces. For greater speeds of the rubbing surfaces oils of lower viscosity are required. The oil must resist change from the action of the air and of high temperatures, must have a reasonably high flash point, must be quite free from inorganic acidity and not have excessive organic acidity. Its boiling point should be high and its cold test low. The author discusses the properties of the various animal and vegetable oils, which possess greater oiliness than mineral oils, as regards their suitability for use in compounding mineral oils, and the requirements in lubricating oils of engines and machines of different categories.

H. M.

185. Process of Manufacturing Lubricating Oils. R. W. Hanna, O. E. Cushman, and T. W. Doell (Standard Oil Co. of California). U.S.P. 1,566,000.

Lubricating oil having a green fluorescence is obtained by combining, with a lubricating oil base obtained by standard methods, a stabilised lubricating oil stock obtained by partly cracking a petroleum oil, the light products being removed either progressively during the operation or subsequently in a separate operation. If necessary, the residue from the cracking process may be reduced, by distillation under reduced pressure, before blending.

W. S. N.

186. Manufacturing Lubricating Oils. J. C. Black and J. W. Weir U.S.P. 1 572,465.

The authors of this patent claim the following process for treating an acid-treated lubricating oil: The acid sludge is removed, and to the oil is added a decolourising and neutralising agent (or agents) (*e.g.*, clay, fuller's earth, montmorillonite, infusorial earth, silica gel); the mixture is then heated to at least 180° F. but preferably above the boiling point of water, then separation of the solid from the liquid is effected (*a*) whilst still hot (*b*) during cooling or (*c*) after cooling. If necessary the oil is then subjected to air-blowing. It is stated that the sulphur dioxide eliminated during the heating of the oil with the decolourising agent serves a useful purpose in providing a non-oxidising atmosphere. The cooling of the oil after treatment with the decolourising agent is preferably performed in a closed apparatus from which air is excluded.

W. S. N.

187. Lubricant for Wire Drawing. K. Lanster. U.S.P. 1,529,829.

The lubricant consists of a mixture of tallow (30 parts), sulphuric acid (6 parts), talc powder (10 parts), soap powder (5 parts), rye flour (20 parts) and water (19 parts).

S. F. B.

188. Lubricating Transmission Bands. T. J. Sniders and W. E. Marshall. U.S.P. 1,541,598.

A mixture of 25 parts of castor oil, 75 parts heavy tallow and 25 parts heavy mineral lubricating oil, can be used to impregnate brake or transmission bands. S. F. B.

189. Process of Separating Wax from Mineral Oil Distillates. S. H. Hall and C. H. Hapgood, Assgrs. to De Laval Separator Co. U.S.P. 1,571,943, 9.2.26. Appl., 8.9.21.

During the centrifuging of oil-wax mixtures, water is fed into the machine at the periphery and at such a temperature that the solid wax collected there is melted and discharged with the water. G. Bowman.

Cracking.

190. New Process for Bleaching Gasolines Obtained by Cracking or by Catalysis. A. Mailhe. *Compt. rend.*, 1925, **181**, 668—669.

Gasoline containing diolefines or other easily polymerised hydrocarbons is refined and bleached by (*a*) boiling with metallic chlorides (especially stannous chloride) or (*b*) passing the vapours over the chloride at 200° C., followed by soda and water washes, and rectification. The chloride may be repeatedly used and can be revivified when necessary by treatment with hydrogen chloride. The process is also applicable to crude benzol. W. S. N.

191. Systematic Refining of Cracked-Distillates. J. C. Morrell. *Petroleum Zeitschrift*, 1926, **6**, 219; *cf.*, *Oil Eng. and Finance*, 1925, 399.

For purifying cracked distillates, the use of sulphuric acid, alkali, lead oxide and water is sufficient, the use of sulphur may usually be omitted and is only necessary in quite special cases.

Alkali removes hydrogen sulphide, and, if they are present, the lower members of the mercaptan series. Plumbite solution serves the same purpose, whereby lead mercaptides are formed, of which some remain in solution, whilst others are precipitated. Further precipitation occurs during distillation, according to the reaction: $Pb(RS)_2=R_2S+PbS$. Since the alkyl sulphide does not react with "doctor" solution, the benzine is "sweet." A previous treatment with plumbite solution gives lead sulphide and lead mercaptides, which react as follows with sulphuric acid: $(RS)_2Pb+H_2SO_4=2R{\cdot}SH+PbSO_4$; $2R{\cdot}SH+H_2SO_4=2H_2O+SO_2+R_2S_2$, or, combining both reactions, $(RS)_2Pb+2H_2SO_4=R_2S_2+2H_2O+SO_2+PbSO_4$.

If insufficient acid is present, certain mercaptides are precipitated as such. In rare cases, *i.e.*, when an excess of hydrogen sulphide is present, more complex methods, *e.g.*, the addition of 0·01% sulphur, must be considered. Wendt and Diggs, also Wood, Lowy, and Faragher (*Ind. Eng. Chem.*, 1924, **11**, 1114, and 1118), give the reaction as $(RS)_2Pb+S=R_2S_2+PbS$, but this does not completely express the process, since the precipitate contains unchanged mercaptides. W. S. N.

192. Process of Making Motor Fuel. L. de Florez. U.S.P. 1,437,045 1922. Appl. 4.12.17. Reissued 16,239, 1925.

Crude oil or a distillate heavier than gasoline is cracked at 500° to 600° C. under a pressure of 4 to 6 atm. The portion of the product boiling above about 200° C. is then condensed at atmospheric pressure and the remaining

gases and vapours passed through condensers. The resulting gases and cracked spirit are then compressed, either before or after refining, to about 5 or 7 atm. and mixed together. H. G. S.

193. Improvements in or Relating to the Cracking of Hydrocarbons. Sinclair Refining Company, E. C. Herthel and H. L. Pelzer. E.P.232,178, 1925.

During the cracking of heavy oils, the length of a run can be considerably prolonged by maintaining in the cracking still a body of adsorptive material, such as fuller's earth, through which the charge is repeatedly circulated. H. G. S.

194. Process and Apparatus for Cracking Hydrocarbons. F. B. Koontz. U.S.P. 1,567,062, 1925. Appl. 8.5.24.

High boiling point hydrocarbons are cracked by passage through a heated coil and are then caused to flow into a horizontal separating chamber in which carbon is deposited. The contents of the separating chamber are maintained at a temperature below that at which cracking occurs. The vapours produced travel through a dephlegmator which returns heavy condensate to the chamber, the remaining vapours being subsequently fractionated and the condensed heavier oils mixed with fresh cracking stock and recycled. H. G. S.

195. Condensation of Hydrocarbon Vapours. Edward W. Isom and J. E. Bett. U.S.P. 1,573,167.

Means for condensing vapours, in particular cracked distillates from pressure stills, by introducing them into a large volume of similar distillate, a portion of which is circulated through a cooling arrangement by the movement of the vapours, and reintroduced into the main body of the condensate with said vapour. A. W. G.

196. Apparatus for Cracking Hydrocarbon Oils. C. P. Dubbs. U.S.P. 1,568,400, 1926. Appl. Feb. 4, 1925.

An apparatus for the cracking of hydrocarbon oils under pressure consists of heating coils connected with an enlarged reaction chamber, the latter being provided with a dephlegmator to condense a portion of the vapours.

The unvaporised oil is returned by means of a pump, together with fresh stock, to the entrance to the heating coils, means being provided whereby the pump may be by-passed in case it becomes inoperative. H. G. S.

197. Method and Apparatus for Continuous Distillation of Tars and Oil. E. Blumner. U.S.P. 1,573,370, 1926. Appl. 11.4.21.

An apparatus for the continuous distillation or cracking of tars and oils consists of an autoclave, almost filled with a molten metal or alloy, and heated by means of hot gases. Inside the autoclave is placed a sheet-metal container, which is fitted at its upper and lower ends with sieves and is filled with Raschig rings or the like. The walls of the container are also supplied with slits or baffles so that the molten metal may circulate freely both within the container and through the annular space between the inner and outer vessels. The oil or tar to be cracked is pumped through a pipe passing downwards through the inner vessel, and emerges as a fine spray or vapour. Thence it travels upwards through the molten metal and between the Raschig rings, and is prevented by the container from coming into contact with the hot walls of the autoclave. By this means, deposition of carbon is inhibited.

The cracked vapours are then released and fractionally condensed. H. G. S.

198. Apparatus for Transforming and Distilling Hydrocarbons and the Like. A. A. F. M. Seigle. U.S.P. 1,572,691, 1926. Appl. 16.7.20.

An apparatus for the distillation or cracking of oils consists of a series of double-walled cylindrical drums, placed end to end in a vertical, horizontal or inclined position. The annular space between the two walls is provided with a longitudinal partition extending throughout the whole length of the retort, and with annular transverse partitions dividing the space between the walls into a series of annular chambers. The transverse partitions are fitted with apertures situated alternately on opposite sides of the longitudinal partition.

The material to be treated flows successively through each of the annular chambers in series and in alternately opposite directions, and is progressively heated in its passage through the retort by hot gases, which pass through the centre channel of the retort in counter-current to the oil.

Means are also provided whereby the annular spaces may be periodically cleaned. H. G. S.

199. Improvements in, or Relating to, Oil Cracking Stills. Sinclair Refining Company, and J. E. Bell. E.P. 231,840, 1925.

The overheating of oil-cracking stills by direct radiation from the fire-box is prevented by the erection of a bridge wall between the furnace and the still.

To effect greater heating efficiency, gas or air is preheated to approximately the temperature of the waste gases, leaving the heating chamber and mixed with the hot products of combustion from the fire-box. H. G. S.

200. Process of Converting (Cracking) Hydrocarbon Oils. J. H. Adams. U.S.P. 1,568,016, 1925. Appl. 12.10.22. Addn. to 1,320,354, 1919.

Heavy oil distillates are cracked by passing through a receptacle in which is placed an electrically-heated resistor, preferably of carbon rods. The operation takes place under pressure. The vapours of desired volatility are condensed, also under pressure, whilst the heavier vapours are returned for further treatment. H. G. S.

201. Process and Apparatus for Decomposing Oils. C. M. Alexander. U.S.P. 1,573,532, 1926.

Heavy oils, *e.g.*, crudes or residues, are sprayed into a large body of oil, which is maintained at a high temperature and is energetically agitated. Fresh oil is sprayed into the still at the rate of evaporation therefrom of the light cracked products, so that a constant level of liquid is maintained. The heavy oil is circulated through a settling chamber, in which carbon is deposited, and is returned to the still. H. G. S.

202. Process for Refining Hydrocarbon Oils. J. C. Morrell. U.S.P. 1,568,904, 1926.

Straight-run distillates, or more particularly cracked spirits, are refined with sodim plumbite, in solution of sulphur dioxide, or exceptionally hydrogen sulphide, being added as a precipitant in place of sulphur. H. G. S.

203. Gasoline Production by Cracking of Heavier Hydrocarbons. A. D. Smith. U.S.P. 1,550,115.

The residual heavy oil from cracking is filtered to remove particles of free carbon, centrifuged to remove some of the colloidal carbon and the purified oil returned to the cracking zone. S. F. B.

204. Apparatus for Treating Hydrocarbons. F. C. Vande Water and F. R. Sunderman (Petroleum Laboratories Inc.). U.S.P. 1,567,212.

The inventors claim the following form of vapour phase cracking apparatus, by means of which they state that very precise control of the cracking temperature is possible. The vapour from a still is led through a cracking tube located beneath the still. The cracking tube is surrounded by a protective element or tube, spaced from it. The still and protective element are heated by a common means. Cool air is circulated, as necessary, through the protective element, around the cracking tube. W. S. N.

205. Pressure Still for Oil Refining. D. Pyzel (Simplex Refining Co.). U.S.P. 1,574,935.

As a means of detecting hot spots due to deposition of coke in a pressure still, the use is claimed of a number of thermo-couples which are embedded in bosses on the exterior of the still shell, together with suitable indicating devices, *i.e.*, each thermo-couple passes through the outer surface only of the shell, being in thermal contact with the metal and not with the oil. W. S. N.

206. Method and Apparatus for Cracking Oils under Pressure. J. E. Bell (Sinclair Refining Co.). U.S.P. 1,575,031.

For regulating the pressure in a pressure still, the latter is provided, according to this invention, with a fixed orifice through which a predetermined and practically constant escape of gas and uncondensed vapour occurs, the vapour being subjected, before it reaches the orifice, to partial condensation regulated according to the still pressure; the greater the pressure, the greater the proportion of vapour which is condensed. The condensing action is regulated automatically by the still pressure; the latter can therefore only vary by slight amounts and remains substantially constant.

Partial, variable condensation of vapour is effected in a reflux tower which may be of various types. It is particularly advantageous to employ internal cooling coils through which part or all of the feed oil for the still is passed at a variable speed, the valve for regulating the flow being automatically operated by the still pressure; the feed is thus usefully preheated. Condensate from this variable condenser may be collected (and either used as a special cut petroleum or separately cracked, perhaps by a vapour phase process) or returned to the still for recirculation. Alternatively the condenser may be of the baffle-plate type, in which the cooling liquid and the vapour are in actual contact, feed oil being supplied to the top at a pressure-regulated flow, provision being made for taking oil from the base of the condenser to the still or elsewhere. This method offers the advantage that light or intermediate constituents of the feed oil are partly separated before it enters the still. Instead of feed oil, any other suitable cooling liquid may be used, but apparently the condenser design is then limited to the internal-coil type; the flow of cooling liquid is then conveniently regulated by means of a variable speed motor, driving the circulating pump. Electrical control of the motor is actuated by the still pressure, in the sense that an increase of pressure causes a faster flow of cooling liquid.

In any of these arrangements, condensation in the variable condenser occurs under still pressure; the vapour for the variable condenser is taken from the top of a fixed condenser which is directly attached to the vapour dome of the still and (apparently) acts as a dephlegmator. The fixed proportion of vapour escaping through the fixed orifice, which is by-passed by a safety-valve, is subsequently dealt with at any predetermined pressure between that of the still and atmospheric.

Claims are made for pressure regulation by means of the fixed orifice in conjunction with regulated partial condensation at still pressure, and, further, for the particular means of effecting this mentioned in the second paragraph (above). W. S. N.

207. Improvements in or Relating to the Purification of Hydrocarbons. T. T. Gray. E.P. 222,481, 1925.

Heavy oils are cracked by distillation under pressure and the vapours conducted round a chamber containing a catalyst, to bring the latter to substantially the temperature of the vapours, and then through the catalyst. Suitable catalytic reagents are fuller's earth, bone-black, bauxite, keilzelguhr, infusorial earth or the like. Polymerisation of certain of the unsaturated compounds in the vapours takes place producing liquids of high-boiling point, which therefore separate from the vapours and may be returned to the still or collected separately and worked up as lubricants. The vapours pass through a condenser and appear as finished products of improved odour and water-white colour.

Suitable apparatus is described. H. G. S.

208. Improvements in or Relating to the Cracking and Separating of Mineral Oils. V. L. Oil Processes, Ltd., and O. D. Lucas. E.P. 244,875, 1925.

Heavy hydrocarbon oils, low-temperature coal tars, shale oils etc. are submitted to a preliminary cracking reaction in the vapour phase in contact with a moving mass of coke. Carbon is deposited on the latter, the excess being periodically removed from the retort. The vapours then pass into a second heated retort containing a catalyst (see E.P.'s 5847, 1914: 209,355, 1923) when cracking occurs without substantial decomposition of coke. The retorts are maintained at from 450° to 600°C., preferably 500°C., and a little ammonia is passed in with the oil, its decomposition providing a small amount of nascent hydrogen.

Means are provided whereby a portion of the heavy liquid products and of the permanent gases formed may be returned to the retorts. H. G. S.

Coal and Shale.

209. Distillation and Extraction of Swedish Oil-shale. B. Holmberg and others. Skifforundersöknigar IV (ingeniors vetenskaps akademien handlingar 14, 1925); *cf.*, *Brennstoff-Chemie*, 1926, 7, 89.

The shale investigated was from Högenäs in South Sweden; it belonged to the Lias formation. The content of organic material varied between 28 per cent. and 90 per cent.; some samples were therefore, practically, coal. By low temperature distillation at 500° in the Fischer aluminium shale apparatus, 100 gm. yielded 7—5 litres of gas and 7—12 gm. tar. The tar contained 15—30 per cent. phenols and 2—5 per cent. solid paraffins, also unsaturated hydrocarbons of low hydrogen content. Extraction of the shale by means of acetone (ether and benzene were less efficacious) gave 1·5 per cent. soluble organic matter; the acetone extract contained 67 per cent. acid constituents and was for the most part soluble in alcohol. Alcoholic caustic soda dissolved from the shale 1 per cent. to 6 per cent. of organic material. With nitric acid, besides carbon dioxide and water, large quantities of nitro compounds (partly soluble in acetone) were formed. Oxidation at 100° by means of oxygen gave 0·5—0·1 c.c. carbon

dioxide per gram of shale, the oxygen absorbed being from 5 to 10 c.c. Comparative oxidation experiments with other Swedish and Esthonian shale are reported. W. S. N.

210. Apparatus for Separating and Extracting Mineral Oils from Oils, Sand, Bitumen from Oily Chalk, Oily Slate, Coal, etc. By Heinrich Preker, U.S.P. 1,567,983.

By means of drums rotating in opposite directions, and directing-plates, oil-bearing material is caused to take a zig-zag course through an extracting medium of hot water with or without added chemicals, said medium moving in an opposite direction to the incoming oil-bearing material. A. W. G.

211. Karwendel Oil-shale. E Berl and W. Schmid. *Brennstoff-Chemie*, 1926, 7, 49—54.

Whereas most German bituminous deposits are Liassic, this belongs to the "Keuper" or red marl, and is situated in the Upper Dolomites of the Bavarian Alps. The shale is found, in particular, along the whole length of the Karwendel Mountains, on both the Bavarian and Tyrollese sides.

The shale is black and stratified, and exhibits a lacquer-like lustre; it has a density of 1·76. If ignited it will continue to burn alone. The air-dried material has a gross calorific value of 3713 Cal., and gave the following analytical figures: Moisture, 1·25 per cent.; ash, 52·08 per cent.; sulphur, 3·98 per cent.; nitrogen (Kjeldahl), 0·36 per cent.; total volatile matter, 37·98 per cent. The coke contained 1·91 per cent. sulphur.

Coking was carried out both *in vacuo* and at atmospheric pressure. When heated at 10—50 mm. (this varies considerably owing to the evolution of gas) the shale lost water at 220°—280° C.; there was briak evolution of gas and oil between 335° and 490° C.; between 490° and 580° C. a thick oil was gradually distilled, and at 580° C. evolution of gas ceased. When the temperature was raised during 3 hours to 545° C. and kept so for a further hour, the yield of oil was 17·9—18·8 per cent. of gas 4·94—5·45 per cent. The coke produced *in vacuo* was dry, porous, and friable, and was not caked together. When coking was conducted at 545° C. under atmospheric pressure, the yields of oil and gas were, respectively, 13·3—14·4 per cent. and 3·8—4·6 per cent.; the coke was not entirely free from tar or asphalts.

Besides small quantities of carbon oxides, nitrogen, and oxygen, the gas contained up to 34·9 per cent. hydrogen sulphide, up to 44·9 per cent hydrogen, up to 39·4 per cent. methane, and up to 8·6 per cent. unsaturated hydrocarbons, the proportions of these varying with the temperature of coking. Of these, the contents of hydrogen and methane increase with the temperature, the content of hydrogen sulphide decreases, and the unsaturated hydrocarbons are formed to a maximum extent at 480° C.

The oil, distilled under 12—20 m.m., gave three liquid fractions: (1) 35°—120° C., 26·54 per cent., a pale yellow oil, of sp. gr. ·878, containing 12·71 per cent. sulphur (2) 120°—220° C., 35·77 per cent., a brown oil, of sp. gr. ·957, containing 11·12 per cent. sulphur, (3) 220°—280° C., 30·07 per cent., a dark reddish-brown, viscous oil, sp. gr. ·994, containing 10·45 per cent. sulphur. At 280° C. decomposition commenced. The residue, 7·62 per cent. was solid pitch.

An attempt to desulphurise the combined distillates by treatment with copper oxide for 15 hours at 150°—170° C. resulted in but a slight reduction of the sulphur content. By the following process, however, the sulphur content was brought down from 9·98 per cent. to 8·06 per cent. Oil (300 gm.) and soda-lime (60 gm.) were kept several hours at 170°—180°, the oil was then treated with sodium and ammonia, and redistilled at the ordinary pressure,

120°—230° C. A pale yellow oil was obtained (211 gm.,) which gradually darkened to a clear reddish-brown; it gave a positive test (colour reactions) for thioxene (dimethylthiophen).

When treated at —12° C. with liquid sulphur dioxide, 8·12 per cent. of insoluble, saturated hydrocarbons was obtained, this portion being yellow and odourless (sulphur 1·96 per cent.). The soluble portion was bordeaux red, and had a pleasant odour (sulphur 8·61 per cent.). It is pointed out that in the presence of a large proportion of aromatic and unsaturated hydrocarbons, the solubility of the saturated hydrocarbons in liquid sulphur dioxide is increased; in fact the oil may dissolve completely (*cf.*, Moore and Morell, *Chem. Met. Eng.*, 1918, **18**, 396). W. S. N.

212. Desulphurisation of Cresols and of Acid Fractions from Various Coal Tars. G. Stadnikoff, N. Gawriloff and W. Rakovsky. *Brennstoff-Chemie*, 1926, **7**, 65—68.

The presence of sulphur compounds in technical cresols inhibits their catalytic reduction either by Sabatier's method, or by the use of active carbon (*cf.*, Stadnikoff, Gawriloff and Winogradow, Brennstoff-Chemie, 1926, **7**, 7; this vol., abs. 82, p. 24 A). Hence the desulphurising of cresolic oils is of great practical importance. Nevertheless, the problem thereby presented is of peculiar difficulty, since, unlike petroleum, phenol and its homologues share with the compounds it is desired to remove (thiophenol and thiocresols) the property of reacting with, and being removed by, aqueous alkali. A method for removing the acidic sulphur compounds from commercial cresol has now been elaborated, depending on the greater velocity of condensation, with aldehydes, of the thio derivatives. Both formalin and glucose syrup are employed, preferably the latter, and as catalyst concentrated sulphuric acid, or, better, a mixture of homologous naphtha-sulphonic acids (designated as "kontakt"). This catalyst offers the advantage that by its use an emulsion is formed of the aqueous aldehyde in the cresol. The temperature employed is 120°—130° C., the period of reaction up to 18 hours. One per cent. of formalin, or 3 per cent. glucose syrup and 1 per cent. "kontakt" are used. In order to avoid decomposition of the condensation product, the cresol is subsequently removed *in vacuo*. The yield of purified distillate reaches 85 per cent. When glucose syrup is employed it is advisable to mix it, together with the catalyst, with an equal quantity of the crude cresol, this mixture then being added in portions to the main bulk of cresol. The water in the syrup is distilled off during this process; this is an advantage. Crude cresol containing 2·24 per cent. sulphur gave purified cresol containing 0·02 per cent. and 0·03 per cent., with formalin and glucose syrup respectively. The process is applicable with success to any cresolic fraction, provided the latter does not contain more than, say, 10—15 per cent. of neutral oil; desulphurisation of an oil containing 50 per cent. of neutral constituents cannot be effected by the method described. W. S. N.

213. Occurrence of Vanadium and Molybdenum in a Swabian Oil Shale. Kahl Neubronner. Chemiker, Zeitung, 1925, **49**, 409—410.

Analysis of a Swabian (Holzkeimer) shale oil showed that besides many other substances, vanadium and molybdenum were present to the extent of 0·04 per cent. and 0·01 per cent. calculated as V_2O_5 and M_2O_3 respectively, these percentages being based on the raw shale. S. F. B.

214. Asphalts and Bituminous Shales as Starting Material for Mineral Oils in Italy. Petroleum Zeitschrift, 1926, **22**, 182; *cf.*, Atti congresso naz. chim. ind., 1924 **201**, 6; also Chemical Abstracts, 1925, p. 1047.

An account of the occurrence in Italy of asphalt and bituminous minerals, and of the method of working at Ragusa. Sixteen furnaces are capable of producing 30,000 tons of oil per annum from rich and poor shales. In the central zone of the retort part of the shale is burnt; decomposition occurs in the upper part of the retort, from which the oil distils; the heat remaining in the burnt ore in the lower zone serves to heat an incoming draught of air. One ton of oil is obtained from 18—20 tons of a poor shale. The temperature in the burning zone reaches 750° C.; the residue is separated at a temperature of 150° C., the oil-saturated gas at 42° C. The oil is dark red and has sp. gr. 0·963 to 0·967, viscosity at 20° C. 13·9—14·4° E., at 50° C., 2·4—3·2°, and at 100° C., 1·2—1·5°. At 250° C. there is 6·5—8·8 per cent. distillate; 250°—300° C., 11·5—13·5 per cent. The paraffin content is 1·8—3·1 per cent.; bromine and iodine are absorbed. The lubricating oils obtained are comparable with the best American and Russian products, the viscosity can be increased by vacuum distillation. W. S. N.

215. The Composition of Coal-Tars. K. B. Edwards and E. S. R. Willmore. *J.S.C.I.*, 1926, **45**, 54—56T.

A high-temperature coal-tar of d^{15} 1·272, having an alkaline reaction and an ammoniacal odour was separated into its constituents in the manner previously applied by Edwards to low-temperature coal-tars (J.S.C.I., 1924, **43**, 143—156T). The final results, calculated by weight on the dry tar, were: Neutral oils 46·6 per cent.; phenols 3·6 per cent.; rhetinols 0·9 per cent.; bases 2·0 per cent.; acids (carbonylic) 0·026 per cent.; asphalt (benzene soluble) 17·0 per cent.; asphalt (benzene-insoluble) 12·4 per cent.; ulmins 15·1 per cent.; "free carbon" plus ash 3·3 per cent.; acid ulmin 0·7 per cent.

The neutral oils were orange-yellow in colour, possessed a strong green fluorescence, contained naphthalene and other crystalline substances which caused the oil to solidify and distilled without appreciable decomposition to the point of pitch formation; the pitch was brittle and, to a large extent, resembled low-temperature tar pitch.

The mixed phenols as regards distillation range and specific gravities of successive fractions were almost identical with those occurring in low-temperature (coalite) tar, their essential nature being inappreciably affected by the temperature of carbonisation.

The rhetinols, ulmins, ulmic acid and carbonylic acids were apparently identical with the analogous substances isolated from low-temperature tars whilst the asphalts were practically black, semi-plastic substances, neither basic nor phenolic, insoluble in light petroleum and alcohol partially soluble in benzene and acetic acid and easily soluble in carbon disulphide, carbon tetrachloride, pyridine and phenols. H. G. S.

216. Process for the Separation of Low-Temperature Tar into Phenols and Hydrocarbons. Z. M. Stinnes. E.P. 245,633, 1926.

Low-temperature coal tar or its distillates are treated with dilute alcohol of, say 56 per cent. strength and gaseous ammonia passed in, with external cooling, until the whole mass is saturated with ammonia.

Separation into two layers ensues after a short time, the upper layer consisting of neutral oil, with a little alcohol and ammonia, while the lower lay, contains the phenols in aqueous, alcoholic and ammoniacal solution.

After separation, the two liquids are separately heated to expel water, alcohol and ammonia, all of which are used in the next operation. The neutral oils and phenols are thus obtained in a high degree of purity. H. G. S.

217. Process of and Apparatus for Distilling Oil Shale, Bituminous Coal and the like to obtain light Hydrocarbons. A. L. Mond (from Amer. Shale Reduction Co.). E.P. 244,275, 1925.

Oil shales, bituminous coals, lignites and the like are fed into the top of an inclined, rotating retort in which they are heated to a temperature at which the volatile constituents are about to be evolved *e.g.*, 400° C. for oil-shales. The material then passes into an enlarged retort chamber, which rotates in a bath of molten metal so that the shale, etc., is maintained at from 535° to 580° C., and is made to spread in a thin layer.

The evolved vapours are cracked and simultaneously hydrogenated by the hydrogen produced by decomposition of the water contained in the material under treatment, the spent shale, which descends in a cascade through the vapours, acting as a catalyst.

The solid residues are continuously removed through a valve, whilst the vapours are drawn by suction through a series of chambers which are heated by the flue gases travelling from the furnace to the stack. In the first of these chambers, maintained at about 400° C., further cracking occurs and heavy paraffin wax pitch is condensed and removed continuously or at intervals. Similarly a certain amount of cracking takes place in the second chamber (at 325° C.) in which lubricating oil stock is simultaneously condensed. The remaining vapours then enter a condenser and emerge as gasoline stock.

H. G. S.

Abstracts.

Arranged by W. H. Thomas, A.R.S.M.

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General.

218. The Volga-Don Canal contra The Grosny-Tuapse Petroleum Pipe-line. J. W. Maksimovitch. *The Petroleum and Oil Shale Industry* No. 1, p. 10.

The Volga-Don Canal, a century old idea, has lately been revived by the Sevkasplan, who propose to connect the Caspian Sea, the Volga and Don rivers, the Azov Sea and Black Sea, utilising this system as a means of transporting and exporting petroleum products and commercial products to the outside world, the intention being to connect the Volga at Tsaritzin with the Don at Kalatah by a canal, the cost of this canal to be defrayed in part, by not constructing the Grosny-Tuapse pipe-line. To deepen the River Don and erect the necessary locks, and to dredge out a channel from Rostov into the Azov Sea. The total estimated cost of this undertaking is 125 mill. Rbls.

Mr. Maksimovitch, in criticising this project, points out that several items are either under-estimated or not estimated, and the omission of essential details that would alter greatly the economical results. For the purpose of criticism the distance (Caspian—Black Sea, 1,700 versts) is divided into sections and a comparison made between the cost of The Grosny-Tuapse pipe-line, the cost of exporting 60 mill. poods Grosny oil yearly, and of transporting along the proposed route up to 200 mill. poods per annum.

(1) Grosny-Petrosk. To transport the estimated export of 60 mill. poods, in addition to present deliveries, 20-25 mill. poods for the internal market, will mean laying down another 8-in. pipe-line at a cost of 5,580,000 Rbls. Petrovsk Port is entirely unsatisfactory, and the increased through transit of 60 mill. poods will entail a general enlargement of the harbour, estimated to cost 2,700,000 Rbls. Increased storage reservoirs, sufficient for a six months' stock, approximately, while navigation is closed, must be erected; this will cost 4,200,000 Rbls. These amounts do not enter into the Sevkasplan's estimate.

(2) Petrovsk Roadstead. Basing upon the present existing system of oil transport, five extra tankers, costing 9,600,000 Rbls., will be required to carry the proposed 60 mill. poods of Grosny oil, and 100 mill. poods of Baku

oil will require seven tankers at a cost of 13,400,000 Rbls. These figures are also in addition to the Sevkasplan's estimate.

(3) Roadstead Astrakhan. To carry the 60 mill. poods of Grosny oil will necessitate an increased shipping tonnage at a cost of 1,580,000 Rbls., to which must be added the cost of deepening the Roadstead-Astrakhan fairway to the normal pre-war depth 7 ft. 7 ins. Should it be considered desirable to ship petroleum direct from Petrovsk to Astrakhan, without transhipping at the Roadstead, a sum of 10,200,000 Rbls. must be spent on a Volga-Caspian Channel, and some additional sums on the strengthening of the Caspian Fleet, then the Roadstead tonnage will not be required.

To transport 200 mill. poods will require an expenditure of 5,260,000 Rbls. on the Roadstead Fleet, with an increased storage capacity, in Astrakhan, of 15 mill. poods at a cost of 1,800,000 Rbls.

(4) Astrakhan—Tsaritzin. The carrying capacity of the Fleet must be increased to 3 mill. poods, costing 3,124,000 Rbls. This figure represents the 60 mill. poods of Grosny oil, but if a total of 200 mill. poods are carried, an amount of 10,400,000 Rbls. will be reached.

The Sevkasplan propose the erection of a refinery at Tsaritzin, the idea being to deliver crude oil to Tsaritzin and the refined products from thereon. As the Volga is frozen over in the winter extra storage will be needed to keep the plant working throughout the year—40,000,000 poods, costing 4,800,000 Rbls., if for 200 mill. poods the figures are respectively 120 mill. poods, the cost being 14,400,000 Rbls.

(5) Tsaritzin—Rostov. The first variant of a pipe-line, 80 versts long, costing 28,000,000 Rbls., from Tsaritzin to Kalatsh, does not mention the transport of light oil products. Evidently these will have to be carried in cisterns by rail to Kalatsh, thus considerably enhancing transport costs. If the Volga-Don Canal is constructed, instead of a pipe-line, the cost is estimated at 60,000,000 Rbls.

The cost of locks on the Don is estimated at 25,000,000 Rbls. To transport the oil from Kalatsh to Rostov a special fleet of 7½–8 mill. tonnage will have to be created at a cost of 9,060,000 Rbls., and for 200 mill. poods carrying capacity 30,200,000 Rbls.

(6) Rostov Port and Azov-Don Canal. At Rostov the storage capacity must be increased to 40 mill. poods at a cost of 4,800,000 Rbls. to allow sufficiently large stocks being kept during the time navigation on the River Don is closed, owing to frost. If the full projected transport of 200 mill. poods is realised the storage should contain 120 mill. poods at an estimated cost of 14,400,000 Rbls.

Rostov must be made into a seaport. As it is situated 48 versts from the mouth of the River Don, a sea channel will have to be dredged into the Azov Sea for a distance of 80 versts. This channel should be 26 ft. deep, the present depth being 10 ft. 6 ins., and sometimes does not reach 8 ft. deep. This is estimated to cost 9,000,000 Rbls.

The Kertch-Enikale Channel, 24 versts long, must also be deepened, entailing a cost of 3¼ mill. Rbls.

As the Azov Sea is frozen over on the average 120 days yearly the question of ice-breakers arises to keep the sea open during winter between Rostov and Kertch, a distance of over 350 versts.

A comparison of the expenditure along the three variants: (1) Volga-Don Canal—construction first on order; (2) Volga-Don Canal—realization of the whole scheme; (3) Grosny-Tuapse pipe-line—will be seen in the tables which are given. T. W.

219. Crude Oils of Trinidad and Canada. *Petroleum World*, 1926, xxiii., 45-49.

The crude oils of the Western Hemisphere have been studied by Messrs. A. J. Kraemer and P. Calkin, and the results are published in U.S. Bureau of Mines Technical Paper No. 346. All gravities are reported in A.P.I. degrees Beaumé.

Calgary, Canada.—Seven samples were examined, the average gravity being 48·1°, the lightest being 54·2°, and the heaviest 37·0°. The content of "gasoline and naphtha" varied from 30·9 per cent. (gravity 61·0°) to 90·1 per cent. (gravity 56·2°). Sulphur content is low, 0·10 to 0·17 per cent. (mean 0·13 per cent.). Only four samples showed an appreciable amount of lubricating constituents. The crude oils of Calgary and of the Rocky Mountain Field, U.S.A., are alike in many characteristics.

Ontario, Canada.—Four samples from Ontario varied in gravity from 23·2° to 36·2° (mean 34·8°). "Gasoline and naphtha" content ranges from 19·4 per cent. (gravity 57·2°) to 28·8 per cent. (58·4°), the mean being 23·6 per cent. (gravity 57·4°). Sulphur content is high, 0·75 to 1·05 per cent., and normal proportions of lubricating distillates are present. Ontario crudes are similar to those from Lima, Ohio.

New Brunswick, Canada.—Two samples from the Stony Creek field were tested, and are typical paraffin-base crudes. They contain about 19 per cent. "gasoline and naphtha" (gravity 62·0°), about 13 per cent. non-viscous and 1·5 per cent. medium lubricating distillate, and carbon residue averages 3·2 per cent.

Far North of Canada.—The examination of a sample from the Fort Norman Well showed it to be similar to that from the Sunburst Sand, Kevin-Sunburst field, Montana.

Mexico.—Crude oils from the Northern District are of heavy gravity, averaging 13·7°, high sulphur content, 5·0 per cent., high viscosity, high pour test, 40° F., and low gasoline content. Southern district oils are lighter—gravity 20·8° to 24·7°; sulphur content varies from 2·95 to 3·79 per cent., pour point averages 30° F., and "gasoline and naphtha" content ranges from 15·0 to 17·5 per cent.

Trinidad.—Crude oil from the Tabaquite field is of two types, "waxy" and "non-waxy." The former has a gravity of about 45·50 and contains an average of 48·3 per cent. (gravity 58·7°) of "gasoline and naphtha," 0·3 per cent. sulphur, and low viscosity and pour test. The non-waxy crudes have a high "gasoline and naphtha" content, sulphur 0·37 per cent., and low viscosity and pour test. Seven samples from other fields ranged in gravity from 16·2° to 24·3° (mean 20·3°), in "gasoline and naphtha" content from 10·5 per cent. (48·1° gravity) to 21·6 per cent. (55·4° gravity), sulphur content 0·54 to 2·63 per cent. (average 1·5 per cent.).

Argentina.—Two samples from the Comodoro Rivadavia field were examined, and gave the following:—Gravity, about 20°; "gasoline and naphtha," about 5 per cent.; sulphur, 0·17 and 0·24 per cent. One sample from Plaza Huincul and one from Mendoza-Neuquen, were of lighter gravity and higher "gasoline and naphtha" content, with a sulphur content of about 0·3 per cent.

Venezuela.—Two samples from the Maracaibo Basin were heavy black oils with an average of 11·9 per cent. "gasoline and naphtha" and 2·58 per cent. sulphur.

Colombia.—Crude oil from the Infantas field was represented by two samples of black oil, with an average of 24·7 per cent. "gasoline and naphtha," 0·7 per cent. sulphur, and low viscosity and pour points.

Peru.—While the two oils examined were alike in many characteristics (averages being "gasoline and naphtha" 43 per cent.; sulphur, 0·07 per cent.; low viscosity), one is a typical "intermediate" crude and the other between that classification and "naphthenic." G. S.

220. Petroleum Position in Ecuador. *Oil News*, 1926, xix., 142-143.

A D.O.T. report, dated September, 1925, states that several companies are engaged in the exploitation of the oilfields of the Guayas Province. The Anglo-Ecuadorian Oilfields, Ltd., obtained about 12,000 tons of oil during the year ended June 30, 1925, and refined 845,802 gallons of crude oil, producing 155,517 gallons of gasoline, 64,216 of engine distillate, and 106,043 of kerosene. Several other companies are operating but have not yet produced oil.

The law of 1914 levied a tax of $15 per annum on each pertenencia of 200,000 square metres, and this law was modified by the laws of 1921 and 1922. The present petroleum law is briefly:—Concessions may be granted for a period not exceeding 40 years; a Royalty of 5—12 per cent. in cash or kind is to be collected by the State; a further annual tax of 20 cents first year, 40 cents second, 80 cents third and $1 thereafter per hectare is levied on State property; applications for leases must be accompanied by name and nationality of petitioner, scale map, deposit of $1,000 and proof of financial and technical capacity; no lease is given to one person or corporation of over 5,000 hectares or under 500 in each canton, or in excess of 15,000 hectares in one province. G. S.

221. The New Pipe-Line in Colombia. *Oil News*, 1926, xix., 201-202.

The Tropical Oil Co., having located a promising oilfield far in the interior of Colombia, a pipe-line is to be constructed from the field to the coast. The work is being carried out by the Andian National Corporation, Ltd. The pipe-line will have a total length of about 800 kilometres, of which 325 will be laid by the middle of this year. The line, which will be 10-inch 41·85 lb. per foot, will be buried the whole way. Its daily capacity will be 30,000 barrels, and tank accommodation will include eleven 80,000-barrel tanks at Malomel, five 55,000 at the field end, and two 30,000 at each pumping station. Rates to be charged for transport vary from $0·4 per barrel for 100 kilometres to $0·75 per barrel for 700-800 kilometres. G. S.

222. Details of New Refinery in Argentina. *Oil News*, 1926, xix, 256-257.

The new refinery at La Plata, opened on December 23, 1925, occupies about 100 acres, and is capable of being enlarged to treble its present capacity of 2,000 tons per 24 hours. Six under-fired stills are provided for crude oil distillation, steam is obtained from three batteries of three boilers each, each of 600 h.p., and three generators of 300 kw. each are installed. Gray Towers are used for fructionation, and a cracking plant is operated for extracting gasoline from gas oil. The unloading system is capable of dealing with a 10,000-ton tanker in twenty-four hours. G. S.

223. The Action of Anhydrous Aluminium Chloride on Nonane and on *Cyclo*-pentane. Mildred V. Cox. *Bull. Soc. Chem.*, 1925, 37, 1549-1553.

The action of aluminium chloride on nonane at 110-120° is to give butane and leave a residue of pentene. The latter appears to polymerise with the formation of some *cyclo*-pentane. The theory is supported by the fact that *cyclo*-pentane is not effected by aluminium chloride. S. F. B.

224. The Nature of the Protoparaffin Waxes in Petroleum. A. Sachanen and M. Bestuschew. *Petroleum*, 1926, **22**, 484-486.

The phenomena of solidification of solutions of technical (pyro-) paraffin waxes and of wax-containing crudes and residues are of the same character. Protoparaffins were precipitated by ethyl alcohol from an isoamyl alcohol solution of Grozny petroleum by Zaloziecky's method, were refined with concentrated sulphuric acid and dissolved in benzine and treated with Floridin. 3 per cent. of wax with m.p. 51·5° to 53·5° C. and 3 per cent. with m.p. 45° to 47° C. were obtained. A third sample of protoparaffin wax was obtained from the precipitate from the inner surface of a pipe-line. This was also refined and then had a m.p. of 75° to 77° C. The solubility of these samples in light benzine, machine oil, benzene and isoamyl alcohol was investigated, and the results are given in tables and graphs. These show that protoparaffins dissolve as true crystalline substances, and that there is no difference between them and pyroparaffins, observed differences in behaviour being due to the accompanying substances in crude oils and residues. H. M.

225. Vapour Pressure of Organic Solutions. E. H. Leslie and A. R. Carr. *Ind. Eng. Chem.*, 1925, **17**, 810-817.

An apparatus suitable for the accurate measurement of the boiling points of organic solutions is described. With this apparatus, the authors have determined the vapour pressures of *n*-hexane, *n*-heptane, *n*-octane and of binary mixtures formed by mixing these hydrocarbons with each other. The temperature range investigated for each system was that in which the liquid under examination showed the same vapour pressure as water in the 50-100° temperature interval. Hitherto it has always been assumed that Dühring's rule only applied to pure substances, but from the data obtained in this work it has now been shown that this rule, which may be summed up in the expression,

$$\frac{T_1 - T_2}{\ominus_1 - \ominus_2} = K$$

(where T_1 and T_2 are the boiling points of one substance at two different pressures and $\ominus_1$ and $\ominus_2$ are the boiling points of another substance at the same pressure) also holds for binary mixtures if each of the components exerts an appreciable vapour pressure. The ternary mixtures investigated were also found to obey the rule. The Dühring lines obtained by plotting T_1 and T_2 (in the above expression) against $\ominus_1$ and $\ominus_2$, usually for water, afford a rapid method for constructing vapour pressure curves: only two boiling point determinations are necessary, a line being constructed from them which gives the necessary data for the vapour pressure curve. A method for the construction of an equilibrium diagram at any pressure, from the Dühring data is described. S. F. B.

226. Corrosion Effect of Naphtha Solutions of Sulphur and Sulphur Compounds. A. E. Wood, Clyde Sheely and A. W. Trusty. *Ind. Eng. Chem.* 1925, **17**, 798-802.

The authors have made a systematic study of the corrosive action of free sulphur and sulphur compounds, dissolved in naphtha, upon commonly used metals and alloys.

The sulphur compounds examined, included *iso*-amyl mercaptan, hydrogen sulphide, dimethyl sulphate, *p*-toluene-sulphonic acid, naphthionic acid,

carbon disulphide, *n*-butyl sulphide, *n*-propyl disulphide, thiophene, diphenyl sulphoxide and *n*-butyl sulphone. These substances were dissolved in specially prepared naphtha, and the resulting solutions, the sulphur contents of which varied from 0·36% to 0·01%, (*p*-toluenesulphonic acid), used as stock solutions in standard corrosion tests. These included the copper dish test and the effect of the solutions alone and in the presence of water upon metal strips left in them, for periods varying from 3 hours to 30 days, at temperature from room temperature to 100°C. The tests carried out on metal strips at 50° showed that the sulphur compounds investigated are without action on iron and aluminium and that zinc although otherwise unaffected is slowly attacked by the alkyl sulphate on prolonged standing. The solutions of free sulphur, mercaptans and hydrogen sulphide attacked silver and copper vigorously but, probably owing to the zinc which it contains, are almost without action upon brass. The addition of water considerably affected the tests, for most of the compounds examined then became active, especially those capable of ionisation or of giving rise to ionisable products (*e.g.* alkyl sulphates).

Thus the action of the mercaptan solution in the presence of water became so marked that a copious yellow precipitate was formed. In the copper dish tests the naphtha solutions of free sulphur and hydrogen sulphide yielded considerable deposits of copper sulphide; the mercaptan solution deposited a tarry substance which on further heating on the steam bath, was readily converted into copper sulphide. Sulphonic acids and their esters also attacked the dish slightly but the deposit was blue, due to the copper salts; the rest of the compounds examined showed no corrosive action in this test.

The tests carried out on metal strips at 100° were considerably complicated by the cracking and polymerisation of the naphtha, which in consequence developed a yellow colour. No definite effect due to this cracking could be traced in the corrosive action of the sulphur compounds, and the results obtained were very similar to those obtained in the tests made at 50°.

The 30-day test was made at room temperature in the presence of water; blank tests were also made side by side with the solution under examination, as it was found that the naphtha alone had some slight action on the metal. The results of this test emphasise the corrosive action of water, for all metals, with the exception of tin and chromium, showed varying degrees of reactivity with water alone. It was also found that the corrosive action of water was nearly always increased by sulphur compounds, this being particularly true for manganese; this action of the sulphur compounds is best explained electrochemically. As in the previous tests, free sulphur, mercaptans and hydrogen sulphide were found to be the most reactive. Summarising the results from the various tests it appears that mercaptans in naphtha solution exhibit the widest range of activity, forming mercaptides with many metals and alloys, which readily decompose to give the corresponding metallic and alkyl sulphides. Next in order of reactivity is hydrogen sulphide, which is closely followed by free sulphur, although the action of the latter is almost entirely limited to copper, mercury and silver. Alkyl sulphates, sulphonic acids and their esters are not markedly corrosive in the absence of water, while alkyl disulphides are only very mildly corrosive in special instances. The remaining sulphur compounds examined do not appear to be corrosive.

In general, it was always found that corrosion was considerably increased by heat and by water and that of the metals investigated, tin and chromium were the least, and mercury and silver the most widely affected. S. F. B.

227. Corrosion Problems in Petroleum Refining. Philip H. Jones. *Oil News*, 1926, XIX, 262, 293–294, 312, 346.

Two corrosion problems have been encountered, on outer surfaces and on inner surfaces. In the case of surfaces in contact with cooling water, such as condensers, untreated water deposited scale on the coils but corrosion was limited. The use of treated water, however, reduced scale formation but caused serious corrosion troubles, the scale apparently forming a protective coating. To obviate this the water was over-treated with lime and maintained at a concentration of 100 parts per million $Ca(OH)_2$, with the result that no great damage by corrosion was observed over several months.

In the case of a refining running crude containing 15 per cent. water, very bad corrosion of inner surfaces took place. The largest damage was in the "secondary" gasoline condensers, except where conditions did not allow the condensation of water, and analysis of the water showed that hydrochloric acid in the water was responsible. To prevent this ammonia gas was introduced into the lines leading to the condenser coils, the quantity being slightly in excess of that required for complete neutralisation. G. S.

228. The Effects of the Lead Tetraethyl upon the Deterioration of Turbine Oils. Sirôzi Hatta. *J. Soc. Chem. Ind. Japan*, 1925, **28**, 1346–1352.

The effect of lead tetraethyl as an anti-catalyst in the formation of oxidation products by the action of heat and air on turbine oils has been studied.

Moist oxygen was passed into samples of the pure oils, containing 0·05, 0·1 and 0·2% of lead tetraethyl, kept at 120°, and fractions removed at definite time intervals. These were tested for colour, specific gravity, viscosity, acid and saponification values, sludge formation and de-emulsibility (Herschel). It was found that paraffinoid oils did not tend to darken so readily in the presence of lead tetraethyl, and sludge formation as well as the falling off in de-emulsibility decreased. The presence of lead tetraethyl did not have any effect on the change in specific gravity, the viscosity, and the acid and saponification values, all of which gradually increased. The effect upon naphthenoid oils was the reverse, with the exception that darkening was retarded; the specific gravity, acid and saponification values as well as sludge formation all increased with oils containing lead tetraethyl.
S. F. B.

229. Chemical Nature of the Crude Oil of Gbely. R. Vondrácek. *Petroleum Z.*, 1925, **21**, 1035–1040.

The crude oil possessed the following characteristics:—Specific gravity 0·9407 at 15°, flash point 102°, viscosity (Engler) 2·98 at 50°, soft asphalt 0·05%, hard asphalt and wax, none, iodine value 19·2 and calorific value 10,600 cals. The oil contains water which is only removed with difficulty. Elementary analyses of the water-free oil gave: carbon 87·5%, hydrogen 11·96%, nitrogen 0·18%, sulphur 0·12%; the residue on ignition was 0·08% of the weight of the oil. Examination of the fractions, obtained on fractionation, for molecular weights gave formulae varying from $C_{14}H_{22}$ to $C_{40}H_{62}$. Many of the hydrocarbons found were similar in composition to those obtained by the pyridine-extraction of coal and an attempt to separate the oil by fractional solution in pyridine gave fractions corresponding to $C_{22}H_{20}$, $C_{21}H_{32}$ and $C_{23}H_{40}$: each fraction contained slightly less than an atom of oxygen.
S. F. B.

230. Viscosity of Liquids under Pressure. P. W. Bridgman. *Proc. Nat. Acad. Sci.*, 1925, **11**, 603–606.

The author has measured the viscosities of a number of liquids at temperatures between 30° and 75° and pressures between atmospheric and 12×10^3 kg. per sq. cm. For all liquids with the exception of water, the viscosity increases with rise of pressure and when this is beyond 1000 kg. per sq. cm., becomes so rapid that it follows a logarithmic curve.

Water is unique in that at low pressures and temperatures its viscosity decreases with rise of pressure to a point (25°), after which it follows the general rule and increases.

The increase in viscosity with pressure varies considerably. With some liquids (*e.g.* Eugenol) at a pressure of 12×10^3 kg. per sq. cm., it is so rapid that it has increase to 10^7 times its original value.

The increase in viscosity under pressure is closely connected with the complexity of the molecule, which can be seen well in homologous series. In order to formulate any theory to cover the facts, it is necessary to take into account interlocking of the molecules. S. F. B.

231. Naphthenic Acids from Niitsu Petroleum. Yoshio Tanaka and Shoichiro Nagai. *J. Faculty Eng. Tokyo Imp. Univ.*, **15**, 8–11.

The starting material was the crude mixture of petroleum acids obtained by acidification of the waste lye produced in the refining of the "neutral distillates" from Niitsu petroleum, the yield totalling 0·23% of the distillate or 0·0792% of the crude oil. An analysis of the crude mixed acids gave: Water 41·6%, neutral oils 23%, organic acids soluble in petroleum ether 7·1%, organic acids not soluble in petroleum ether 8·0%, free sulphuric acid 4·7%, inorganic salts (sodium sulphate, etc.) 15·6%. Purification was effected as follows: 400 gms. of the petroleum ether soluble crude acid substances were shaken with 400 c.c. of petroleum ether and 20 c.c. of ethyl alcohol, the upper layer then being removed and the process repeated five times on the remaining acid layer, but without the addition of alcohol. The solvent was then removed from the combined extracts and the residue distilled over a small quantity of copper oxide at a pressure of 50 mm. The distillate was converted into potassium salts by warming with potassium hydroxide solution at 80°C., and after the addition of a little water and alcohol the neutral oils removed by extraction with petroleum ether. After warming to remove alcohol, the purified potassium soaps were decomposed by hydrochloric acid and the free acids recovered by continued extraction with petroleum ether. The combined extracts were washed with saturated brine, and after drying over calcium chloride freed from solvent by distillation. In this manner 5·93 gms. of acids were obtained which possessed the properties: d_4^{15} 0·9937, n_D^{15} 1·4917, and acid value 223·9. 400 gms. of the purified acids were fractionated at 8·9–9·0 mm. fractions being collected at 10° intervals, from 167–243°. 85% of the distillate boiled in the range from 180–230°. The density of the fractions increased from 0·9914 for the fraction b.p. 180–190°/8·9–9·0 mm. to a maximum in the 200–210° fraction (0·9992) and then decreased, the density of the highest fraction being 0·9738.

The refractive index, however, increased steadily with the boiling point. The lower fractions contained traces of phenols and these lowered the acid values of these fractions. Thus the acid value increased from 228·5 to a maximum of 243·6 for the 190–200° fraction and then decreased to 169·6. A quantity of the purified acids was also converted into its methyl esters and fractionated in this form. The boiling point ranged from 122–225°.

Again the density rose to a maximum, and the refractive index increased regularly from 1·4612 to 1·4864. In this respect, as also in their density, the esters resemble those derived from the Kurokawa acids.

Fractionation of the acids recovered from the methyl esters by saponification gave pure specimens of the acids, the boiling range of which was from 173–244°.

That considerable purification had been accomplished was best seen in acid values, which now decreased regularly from 245·3 to 195·5. The average molecular weight of the acids was found to be 248. S. F. B.

232. Separation and Purification of Naphthenic Acids. L. Gurwitsch. *Brennstoff. Chem.*, 1925, **6**, 322–323.

Neutralisation of the sodium soaps obtained in the isolation of naphthenic acids from petroleum distillates, by sulphuric acid leads to the formation of sodium sulphate, which is worthless. By replacing the sulphuric acid with sulphur dioxide sodium sulphite is formed from which the sodium may readily be recovered as caustic soda by causticisation with lime. Complete decomposition of the sodium salt by sulphur dioxide requires a very large excess of the gas (230%) but at 70°, using 60% of the amount theoretically required, the acids separate easily although 40% of the soaps remain undecomposed. This appears to offer no disadvantage in soap manufacture however.

Purification of the crude acids cannot be effected by acid washing as no tar separates; if, however, 12% oleum is used followed by water (20%) when the reactions are complete, a satisfactory separation of acid tar occurs. S. F. B.

233. Naphthenic Acids Derived from Gas-oil Distillate of Californian Petroleum. Yoshio Tanaka and Shoichiro Nagai. *J. Soc. Chem. Ind. Japan*, 1926, **29**, 1–7.

Acidification of the waste lye produced in the refining of gas oils from mixed Californian crudes, gave a mixture of acids possessing the characteristics: d_4^{15} 0·9972, n_D^{15} 1·4979 and acid value 51·2.

After separation of acid esters, etc., the crude naphthenic acids were obtained having d_4^{15} 0·9797, n_D^{15} 1·4927 and acid value 191·4; these were converted into their methyl esters, in which form they were purified by fractionation boiled between 160–230°/8·9–9 mm. Saponification of the pure esters in the usual manner gave the pure mixed naphthenic acids, the characteristics of which were now:—d_4^{15} 0·9773, n_D^{15} 1·4893 and titration value 208·4. On fractionation at 8·9 mm. they distilled between 136–260°; 82% passed over from 200–260° and had d 0·976–0·985. The gravity of the main corresponding fraction is a little lower than that of the acids of Kurokawu origin (0·99) and higher than those from the petroleum of Nishyiyama (0·97). It is therefore probably a mixture of the two series of isomeric naphthenic acids obtained from these sources. The fraction b.p. 210–220° had the maximum gravity (0·985). The pure acids from the highest fractions deposited a white crystalline mass on standing. S. F. B.

234. Sulphur Compounds removed from a Persian Petroleum by means of Sulphuric Acid. Part I. E. H. Thierry. *J.S.C.*, 1925, **127**, 2756–2759.

The author has examined the black oil obtained by dilution of the acid sludge produced in the refining of a Persian spirit. Fractionation at 125 mm. gave 29 fractions, boiling below 120°, and of these four have been investigated.

The lowest fraction examined boiled at 68–70°/760 mm; it contained besides chloroform, which was employed to extract any sulphur compounds from the aqueous layer of the acid sludge dilution, methyl ethyl sulphide.

This substance was identified in the form of its mercuri-iodide m.p. 59°. Fraction 7 boiled 89–92°/760 mm.; it appeared to be a mixture containing methyl propyl or methyl *iso*-propyl sulphide, but the quantity was insufficient for complete indentification. Fraction 11 after fractionation at 125 mm., boiled at 120–121°/760 mm., was identified through its methiodide, mercuri-iodide and sulphonium iodide mercuri-iodide as tetramethylene sulphide.

The last fraction investigated, fraction 17, boiled at 138·5°/742 mm. The sulphonium chloride and sulphone prepared from it, in the usual manner, were identified as pentamethylene derivatives, and the substance was therefore pentamethylene sulphide. S. F. B.

235. The Composition of Reduced Nickel Catalysts. B. Kubota and K. Yoshikawa. *Sci. papers, Inst. Phys. Chem. Research*, 1925, **3**, 223–231.

The activity of reduced nickel catalysts is determined by the constitution of the unstable nickel hydrides of which it is composed. Three types of these hydrides exist, the actual type predominating in any catalyst being determined by the temperature of reduction of the catalyst. The hydrides of any one type are capable of catalysing similar hydrogenations. Thus the hydrides of type (1) are capable of hydrogenating the benzene nucleus, type (2) catalyse the hydrogenation of ethylenic bonds, and type (3) are capable of reducing groups such as the nitro group, etc. It has been found that certain substances act as specific poisons for any one group of hydrides, and it is therefore possible to destroy the activity of a class of hydrides without affecting the other hydrides present. Thus the first type of hydrides are poisoned by the thiophene, the second by diethyl sulphide and the third by hydrogen sulphide, and by determining the sulphur content of a nickel catalyst after the activity of each type of hydride has been completely destroyed, it is possible to estimate the contents of the various types of hydrides present in it. Estimation of the various hydrides in nickel catalysts prepared at different reduction temperatures showed that although the proportion of the three types remained almost the same, the quantity of hydrides formed decreased with increasing temperature of reduction. S. F. B.

236. Molecular Coefficients of Refraction. F. Eisenlohr and L. Schulz. *Ber.*, 1924, **57**, [B], 1808–1820.

The authors have redetermined the optical constants of a large number of benzenoid hydrocarbons in consequence of the criticisms of their work by Auwer's and Kolligs. The values after the names of the hydrocarbons in the following list are the boiling point, d_4^{20}*vac* and n_{He}^{20} respectively:

Ethylbenzene, 135–136°, 0·8667, 1·49477; *n*-heptylbenzene, 145·0–145·2°, 0·8694, 1·48640; *n*-octylbenzene, 264·265°, 0·8583, 1·48534; cetylbenzene (prepared by Fittig's method), 235–237°/16 mm., $n_D^{21\cdot5}$ 1·47986; *o*-ethyltoluene 163·7–163·9°/753 mm. 0·8747, 1·50219; *m*-ethyltoluene, 159·2–159·8°, 0·8615, 1·49654; *p*-ethyltoluene, 159·5–160°/763 mm., 0·8584, 1·49483; *o*-propyltoluene, 180·5–181·5°, 0·8740, 1·49909; *m*-propyltoluene, 176·5–177·5°, 0·8625, 1·49398; *p*-propyltoluene, 179·5–180°, 0·8570, 1·49197; *o*-*iso*propyltoluene, 174·5–175·5°, 0·8741, 1·49862; *m*-*iso*propyltoluene, 174·5–175·5°, 0·86193, 1·49396; *p*-*iso*propyltoluene, 176·0–176·5°/762 mm., 0·8580, 1·49141; *o*-heptyltoluene, 263–263·2°, 0·8717, 1·49521; *m*-heptyltoluene, 260·0–260·8, 0·8615, 1·49140; *p*-heptyltoluene, 265·0–265·2, 0·8560, 1·48968. The values for n_α^{20}, n_β^{20} and n_γ^{20} are also recorded. S. F. B.

237. Effect of Pressure and Temperature on Total Volume of Partially Vapourised Midcontinent Crude. R. E. Wilson and H. G. Schnelzter. *Ind. Eng. Chem.*, 1926, **18**, 523—525.

A method is described by which the total volume occupied by a partially vapourised oil at any definite temperature and pressure can be determined. The apparatus used consisted of a bomb of known capacity, which was heated by means of an oil bath and which had, at the bottom, a tube connected to a pressure gauge. In order to eliminate the heat effects, this gauge was placed at some distance from the bomb; the condensation of volatile vapours in the connecting mercury was prevented by filling the tube with mercury and the gauge with water.

Measurements made with the apparatus on samples of a Midcontinent crude containing from 0—1·75 per cent. of water emphasise in a striking manner the effect of the water present. Thus at 300°F. and 40 lbs. pressure the dry crude had only increased by 15 per cent. of its volume, while the crude containing 1·75 per cent. of water had increased in volume by 1,100 per cent.

S. F. B.

238. Molecular Coefficients of Refraction in the Series of Polymethylene Compounds. Fritz Eisenlohr. *Fortschritte der Chemie, Physik physikal. Chem.*, 1925, **18**, 521—566.

A number of hydrocarbons have been prepared and their boiling points, densities ($d_4^{20\ vac}$) and refractive indices for the α, He, β and γ lines determined; in the following list these values are given, after the name of the hydrocarbon, in the order stated:

*Cyclo*pentane, 50°/756, 0·7510, 1·40383, 1·40609, 1·41126, 1·41536; Methyl*cyclo*pentane, 70—70·5°/755, 0·7459, 1·40750, 1·40947, 1·41465, 1·41465, 1·41868; Ethyl*cyclo*pentane, 100·5—1°/756, 0·7610, 1·41612, 1·41840, 1·42332, 1·42798; Propyl*cyclo*pentane, 129·5°/754, 0·7718, 1·42285, 1·42470, 1·43040, 1,43474: Iso*propyl*cyclopentane, 128—9°/754, 0·7717, 1·42255, 1·42470, 1·43010, 1·43454.

Isobutyl*cyclo*pentane, 148—9°/756, 0·7795, 1·42738, 1·42950, 1·43516, 1·43980. *Cyclo*hexane, prepared by hydrogenation of benzene in acetic acid in the presence of a platinum catalyst, 80·3°/750, 0·7783, 1·42476, 1·42680, 1·43229, 1·43668; by hydrogenation of benzene at 180—90° in the presence of nickel, 80·5°/756, 0·7782, 1·42496, 1·42700, 1·432600, 1·43705; Methyl*cyclo*hexane, prepared by hydrogenation of toluene in acetic acid in the presence of a platinum catalyst, 100°/758, 0·7748, 1·42395, 1·42630, 1·43190, 1·43658; from *cyclo*hexane and methyliodide 99·5—100°/759, 0·7708, 1·42175, 1·42390, 1·42931, 1·43367; decomposition of *p*-methyl*cyclo*hexanone semicarbazone with sodium ethoxide, 100°/770, 0·7725, 1·42265, 1·52500, 1·43040, 1·43474. Ethyl*cyclo*hexane, 129·5°/756, 0·7840, 1·43041, 1·433251, 1·43803, 1·44272. Propyl*cyclo*hexane, 154·5—5·5°/756, 0·7898, 1·43383, 1·43592, 1·44160, 1·44616. Isopropyl*cyclo*hexane, 152—3°/756, 0·7902, 1·43428, 1·43642, 1·44225, 1·44686. Isobutyl*cyclo*hexane, 169°/754, 0·7950, 1·43686, 1·43904, 1·44467, 1·44920, *cis-o*-Dimethyl*cyclo*hexane, 126·5°/750, 0·7822, 1·42859, 1I43060, 1·43635, 1·44088, *trans-o*-Dimethyl*cyclo*hexane 124·5°/755, 0·7798, 1·42778, 1·42990, 1·43546, 1·44008, *cis-m*-Dimethyl*cyclo*hexane, 121°/760, 0·7375, 1·42385, 1·42600, 1·43170, 1·43628. The *trans*-derivative 119°/756, —, 1·42265, 1·42480, 1·43030, 1·43493. *cis-p*-Dimethyl*cyclo*hexane, 120·5°/755, 0·7671, 1·42064, 1·42270, 1·42833, 1·43299. The *trans*-derivative 119°/760, 0·7655, 1·41833, 1·42000, 1·42578, 1·43;46. A second sample 119—9·5° 0·7638, 1·41914, 1·42120, 1·42686, 1·43163. *Cis*-Hexahydrohemellitor, 144—6°/755, 0·7930, 1·43475, 1·43682, 1·44259, 1·44724. The *trans*-derivative 142—3·5°/762, 0·7914, 1·43373, 1·43582, 1·44150, 1·44606.

Cis-Hexahydropseudocumene, 141—5°/760, 0·7850, 1·43120, 1·43341, 1·43902, 1·44361. The *trans*-derivative, 138·5—9·5°/755, 0·7813, 1·42909, 1·43121, 1·43675, 1·44135. *Cis*-Hexahydromesitylene, 139·5—40·5°/750, 0·7765, 1·42768, 1·42990, 1·43536, 1·43990. Mesitylene from mesidine, 165°/769, d_4^{20} 0·8642, n_{He}^{20} 1·49957, gave a sample of the *cis*-derivative, 140—40·5°/752 0·7773, 1·42808, 1·43010, 1·43586, 1·44028. The *trans*-derivative 138—9°/760, 0·7720, 1·42506, 1·42710, 1·43279, 1·43735. Isodurene, 195—7°/760, $d_4^{20\ vac}$ 0·8906, n_{He}^{20} 1·51126, on hydrogenation with platinum gives *cis*-hexahydroisodurene, 168—70°/762, 0·8166, 1·44621, 1·44847, 1·45472, 1·45963. The *trans*-derivative 162—4°/765, 0·8140, 1·44440, 1·44657, 1·45212, 1·54667.

Cis-Hexahydrodurene, 171°/755, 0·8122, 1·44420, 1·44647, 1·45252, 1·45756. The *trans*-derivative 166—8°/760, 0·8100, 1·44230, 1·44446, 1·45003, 1·45470, *cis*-*o*-Methylcyclohexanol, 170°/755, 0·9280, 1·46003, 1·46225, 1·46841, 1·47353. The *trans*-derivative 168·5°/750, 0·9254, 1·45943, 1·46165, 1·46771, 1·47284. The *cis*-*m*-methylcyclohexanol, 175·5·5°/760, 0·9250, 1·45873, 1·46086, 1·46692, 1·47196.

The *trans*-derivative 174·5—4·7°/762, 0·9234, 1·45723, 1·45931, 1·46544, 1·47020. *cis*-*p*-Methylcyclohexanol, 175·5°/760, 0·9223, 1·45704, 1·45926, 1·46534, 1·47039. The *trans*-derivative 174·5°/760, 0·9172, 1·45503, 1·45727, 1·46336, 1·46831. *o*-Methylcyclohexanone, 165°/757, 0·9240, 1·44481, 1·44747, 1·45332, 1·45845. The *m*-derivative 170·5°/755, 0·9182, 1·44270, 1·44526, 1·45122, 1·45598. The *p*-derivative 171·5°/759, 0·9128, 1·44099, 1·44346, 1·44924, 1·45401. S. F. B.

239. Hydrogen from Water Gas. R. M. Evans and W. L. Newton. *Ind. Eng. Chem.*, 1926, **18**, 513—517.

The authors have investigated the activity of certain precipitated metallic oxides in catalysing the production of hydrogen from water gas 380° and 444°C. Of the plain oxides tried, cobalt and iron oxides gave excellent conversion; chromium oxide also gave some conversion, but the other oxides examined proved useless, practically no conversion occurring. The effect of mixing the oxides with others capable of acting as promoters was also tried, and it was found that catalysts suitable for low temperature conversion could be prepared by mixing aluminium and potassium oxides with either the cobalt or the iron oxides. The activity of the cobalt catalyst is considerably impaired by the presence of such sulphur compounds as hydrogen sulphide, carbon disulphide and carbon oxysulphide in the water gas, and it is necessary to remove them to prevent poisoning of the catalyst. The iron catalyst is not affected to such an extent, and it may therefore be used with sulphurous water gases: it can be readily restored to full activity by contact with pure water gas. S. F. B.

240. Oil Containers, Treatment of Walls of. James Love Biggart. E.P. 243,220.

To facilitate the cleansing of tanks and other oil containers by the use of steam or water, the interior walls of such containers are coated, prior to the introduction of oil, with a mixture of calcium carbonate and a solution of sodium silicate. G. S.

241. Ultra-Violet Spectroscopy of Motor Fuels. G. L. Clark and W. C. Thee. *Ind. Eng. Chem.*, 1926, **18**, 528—531.

By means of a special apparatus, the authors have photographed the ultra-violet spectra of the flames produced in an internal combustion engine by several commercial gasolines, on explosion, on detonation and on combustion. The effect on the flame spectra, of adding butyl nitrite, lead tetraethyl, alcohol and benzene has also been investigated.

The apparatus used consisted essentially of a single cylinder Delco experimental engine, similar to that described by Midgley and Boyd (*Ind. Eng. Chem.*, 1922, **14**, 589) fitted with a quartz window ½-inch in diameter and ¼-inch thick, mounted in a steel shell screwed into the combustion chamber. The spectra were photographed by means of a quartz spectrometer. The load on the engine was supplied by an electrical generator. In order that the flame could be photographed at any part of the stroke, a shutter was fitted, operated synchronously by gearing from the shaft on the engine; the actual time of opening of the shutter could thus be varied by altering the gearing. Exposures were made varying from 30 minutes to 4 hours, according to the intensity of the flame produced. After each run the quartz window was examined, and if necessary, cleaned. The carbon was removed from the cylinder head by oxygen when necessary; this was always done after a run on fuel containing lead.

Combustion flames were produced by throttling down the motor and adjusting the carburettor to give a blue flame. This type of flame was considered to be due to the slow but steadily increasing oxidation of the fuel. The explosion flame, which is comparatively rapid but constant in velocity, had a characteristic red colour. The addition of lead tetraethyl generally changed it to an almost white flame, but as no detonation-knocking occurred it was still included under the heading of explosion. The velocity of flame propogation in detonation is extremely high, but like the explosion flame it is constant in its speed. The flame generally appeared white and was always accompanied by the familiar knocking. The spectra of this type of flame were always strongly banded. It was found that the spectra of the flames of gasolines are considerably affected by butyl nitrite and lead tetraethyl. The former accentuates the intensity of the far ultra-violet, a fact of interest in connection with radiation theory of anti-knocking, and the latter suppresses the banding characteristic of detonation flames; it also tends to shorten the ultra-violet region.

The strong lead lines seen in the flames of gasolines containing lead tetraethyl, as well as the absence of the lead compound bands, showed that the metallic lead atom, or the process of decomposition of the lead tetraethyl molecule, was the effective agent in increasing flame propogation and that the combination of the lead with the bromine introduced as ethyl bromide, only occurred after the oxidising action was over. The three lead lines λ λ 4058, 3683 and 3639 appear when extremely small quantities of lead are present in the gasoline; in fact the appearance of these lines constitutes the most sensitive test yet found for the presence of lead tetraethyl in gasoline.

Copper lines from the sparking plugs can also be seen. These appear as emission lines when lead is present but in its absence as absorption bands. The authors propose to extend this work considerably in the future. S. F. B.

242. The Problem of the National Motor Fuel Using Alcohol as a Base [Italy]. Luigi Dal Prato. *Rass. min. met. chem.*, 1925, **63**, 136—140.

Tests, carried out with the object of comparing the value of the six following fuels are described: (*a*) Alcohol 40 per cent., benzine 60 per cent.; (*b*) alcohol 38 per cent., benzine 40 per cent., benzene 20 per cent, ether, 2 per cent.; (*c*) alcohol 40 per cent., benzine 30 per cent., benzene 25 per cent., ether 5 per cent.; (*d*) alcohol 50 per cent., benzine 44 per cent., ether 6 per cent.; (*e*) alcohol 76 per cent., benzine 20 per cent, ether 4 per cent.; (*f*) benzine 100 per cent. (*d*) was found to be practically equivalent in performance to (*f*) and to be superior to the others. It was found that the power output varied inversely with the calorific power. S. F. B.

243. "Gasin": A New Anti-Knock Motor Fuel. (*Petroleum Times*), XV., 384.

G. Grote gives some information on a new motor fuel for which anti-knock properties are claimed. He bases his theory of knocking on the work of Tern and Hloch, who state that the greater the "isolation capacity" of the fuel, the greater is the tendency to knock.

The claims for the new fuel "Gasin" are (1) increase in volatility of the fuel, (2) greater purity of the fuel, (3) elimination of knocking and pre-ignition, (4) complete absence of poison in the fuel, (5) no stopping up of valves nor fouling of the oil system, (6) increase in the explosive power of the fuel mixture.

No information is given as regards the chemical composition of the fuel, nor the economic aspect of its production. W. N. H.

244. A New "Anti-Knock" Reagent. *Petr. Times*, 1926, XV., 427.

A new "anti-knock" reagent, which has been introduced by the Badische anilin Sodafabrik Company, is iron carbonyl, a compound of iron and carbon, monoxide gas. The iron carbonyl liquid is prepared in the form of a mixture of equal parts with motor spirit under the name of "motyl," and a treated motor spirit, "motalin," containing only a fraction of 1 per cent. of iron carbonyl, is marketed. G. S.

245. Synthetic Fuel from Carbon Monoxide and Hydrogen. O. C Elvins and A. W. Nash. *Fuel*, 1926, **5**, 263-5.

A mixture of equal volumes of carbon monoxide and hydrogen was passed at a speed of 6 litres per hour over a catalyst prepared by drying up to 150° C. and then reducing at 400° C. a mixture of the hydrated oxides of copper, cobalt and manganese. The gases, after cooling, were passed through active charcoal and collected in a gasometer. As the temperature of the catalyst was increased from 245° to 284° C., the percentage of carbon dioxide in the gaseous products increased rapidly from 4·3 per cent. to 10·7 per cent. A small quantity of a liquid of an oily nature was obtained after a run of 58½ hours, while treatment of the charcoal gave a volatile fraction, 5 c.c. of which, distilling between 45° and 105° C., contained C. 84·1 per cent. and H. 14·1 per cent. This liquid is stable to light and is apparently of a saturated nature. H. G. S.

246. Fuel Oil. F. L. Dietz. U.S.P. 1,573,307 of Feb. 16. Appl., Nov. 16, 1921.

A fuel for internal combustion engines consists of low-temperature tar and a mixture of alcohol and a hydrocarbon, both boiling at 79° C., mixed with the tar to prevent its solidification. H. M.

247. Motor Fuel Oil. F. L. Dietz. U.S.P. 1,573,308 of Feb. 16. Appl., Feb. 2, 1922.

A fuel for internal combustion engines consists of crude tar from the distillation of coal up to 600° and alcohol. H. M.

248. "Anti-Knock" Liquid Fuel. T. Midgley, jun. U.S.P. 1,571,862.

An "anti knock" material for adding to fuels for internal combustion engines consists of aniline (6 parts) cracked spirit (3 parts) and a blending agent such as *o*-toluidine and xylidine (2 parts). S. F. B.

249. MOTOR FUEL. Y. Nikaido. U.S.P. 1,582,420. April 27, 1926. Appl., July 9, 1925.

A mixture of hydrocarbons with a small proportion of a dialkyl ether with a boiling-point below 104° C. to accelerate ignition. S. B.

250. THE SIGNIFICANCE OF EXHAUST TEMPERATURE. P. H. Smith. Paper read before the Diesel Engine Users' Association.

In connection with some work on the early types of semi-enclosed Diesel engines, trouble was experienced in obtaining a reliable indicator diagram, which was badly distorted. This led to investigation of other means of control when tuning up the engine. It was found that there is a straight-line law connecting exhaust temperature and mean indicated pressure. The author considers control by means of exhaust temperature more reliable than the indicator diagram.

Tables are given showing exhaust temperatures and mean indicated pressures, for various types of engine working under varying conditions of load blast pressure, etc. E. S. S.

251. REPORT ON HEAVY-OIL ENGINE WORKING COSTS (1923-4). Submitted to the Diesel Engine Users' Association.

In this report curves are given showing the effect of load factor on fuel consumption, lubricating oil consumption and repair and maintenance costs. Details of the actual costs of thirty-seven stations are also given. The average overall thermal efficiency of these stations, comprising 129 engines of 1,000 b.h.p. downward, is shown to be 23 per cent., which is a better figure than that reported for steam plant.

The following figures show the average condition from a large number of installations :—

Fuel consumption	·789 lb. per unit.
Lubricating oil consumption	·00195 galls. per unit.
Repairs and maintenance	·95d. per k.w. installed.
Cost per unit generated	0·891d.

E. S. S.

252. HEAVY-OIL ENGINE INSTALLATIONS—CHOICE OF SITE AND LAY-OUT OF PLANT. Geoffrey Porter. Paper read before the Diesel Engine Users' Association.

The nature of the subsoil, and its effect on the transmission of vibrations to neighbouring property was stressed. In subsoils consisting of dry sand or gravel the energy of the vibrations is quickly absorbed by the frictional resistance of the particles. A subsoil of a homogeneous nature, or water logged, will transmit with very little loss. If such a strata of subsoil outcrops, it very often happens that a building some distance away from the engine will be affected, while no disturbance will be felt in the intermediate ground.

The causes of vibrations in engines were discussed, and it was stated that a six-crank engine with crank-pins set at 120° gave most freedom from vibration.

Engine foundations should be large and be completely separated from the foundation of the building. All pipes, especially exhaust pipes, should not be fixed to the building, and the joints in exhaust pipes should include asbestos rings.

The concrete raft may be supported on virgin, or compressed cork, and with smaller engines are sometimes supported in springs.

The proximity, and the nature of an ample water supply governs the choice of site. In temperate climates the amount of cooling water required varies between 7—10 galls. per b.h.p. per hour. The hardness of the water should not exceed 3½°, especially the water used for piston or cylinder-head cooling. The systems of water-cooling employed depending on whether pressure supply or pumping was used, were described and enlarged upon.

The paper concluded by tabulated notes setting out the various systems of (*a*) service and main storage tanks, (*b*) oil recovery, (*c*) air supply, (*d*) exhaust, (*e*) sundries. E. S. S.

253. Temperature and Heat Stresses in Diesel Engines. R. Aulzer. *Petr. Times.*, **15**, 383 and 4.

An extensive series of tests were carried out on an Aulzer four-cylinder, two-cycle, marine engine type ST60, operating at 100 r.p.m., with a normal output of 1,350 b.h.p.

The main interest of the tests lies in a large number of temperature records obtained, these comprise temperatures of various points in the piston head, cylinder cover and liner. The variation in temperature of each point during successive revolutions of the engine was recorded photographically.

A symmetrically-shaped cover, piston and liner was used so that from the above temperature records stresses could be calculated. A large number of curves are given showing temperature distribution and heat stresses.

W. N. H.

254. The Use of Strongly Phenolic Oils, Particularly Coal-Tar Oils, for the Operation of Diesel Engines. A. Spilker. *Brennstoff-Chemie*, 1926, **7**, 170-173.

The generally-accepted view, that oils containing a high percentage of phenols are unsuitable as fuel for Diesel engines, is incorrect. Such oils only suffer from the disadvantage, common to other oils, of containing sulphur compounds which are injurious to some metals. Phenolic oils which do not contain objectionable sulphur compounds can be used for the operation of Diesel engines. The decrease in calorific value, compared with that of a non-phenolic oil, is only 1 per cent. to 1½ per cent. for a content of 10 per cent. of the higher phenols. Phenols, although admittedly acidic, do not attack any of the metals which enter into the construction of Diesel engines. Resinification does not cause any difficulty in operation. A 500-h.p. Diesel engine was run successfully for three months on a coal-tar having 40 per cent. phenolic substances, calorific value (net), 9,100 cals., without any trace of corrosion and without any difficulty of operation. W. S. N.

255. Anti-Knock Materials. W. H. Charch, E. Mack, Jnr., and C. E. Boord. *Ind. and Eng. Chem.*, **18**, 4. 334—340.

Part I. of the paper outlines experimental work using a single cylinder internal combustion engine and a Midgley and Boyd bouncing-pin for determining the efficiency of various organo-metallic substances for the suppression of detonation. The authors define "anti-knock coefficient" as the inverse ratio of the numbers of mols. of a given compound required to give the same degree of suppression of detonation as does one mol. of lead tetraethyl in a constant volume of the same basic fuel mixture. Compounds of nickel, bismuth, cadmium and titanium were found to be suppressors of detonation. Considerable negative evidence is quoted.

Part II. describes efforts to correlate the behaviour of anti-knock compounds in internal combustion engines with their behaviour when mixed with

acetylene or hydrogen and ignited in an open tube at atmospheric temperatures and pressures. The authors deduce the fact that if a compound behaves as an anti-knock in the tube it does not necessarily behave as such in the engine and *vice versa*. The theory is suggested that detonation in an internal combustion engine is a sudden disruption of the molecules as opposed to the very rapid oxidation of the molecules which occurs when explosion takes place.

Part III. describes experiments measuring the average conductivity of the gas in an internal combustion engine. It was found that the conductivity increased very much when detonation was taking place in the cylinder, and a method is suggested for measuring the efficiency of anti-knock materials based on this change in conductivity.

Part IV. endeavours to trace a connection between the chemical formula and properties of any substance and its behaviour as a suppressor of detonation It is found that all organo-metallic compounds which function as knock suppressors are volatile below 400° C. and decompose on heating at atmospheric pressure depositing the free metal. From this it is inferred that the heat of compression in an internal combustion engine produces such decomposition throughout the explosive mixture, the free metal on further compression and heating spontaneously oxidises, thus producing a very large number of nuclei of high temperature throughout the mixture. These nuclei "initiate evenly ahead of the main flame front (from the sparkling plug) a partial oxidation or auxiliary burn tending to maintain normal combustion in a region of fuel which would otherwise be subject to detonation."

Evidence is adduced to support this theory. Thus, organic mercury compounds fail to act as knock suppressors because mercury is not oxidised under the conditions obtaining in an internal combustion engine, also organo-metallic bodies containing oxygen fail to act as knock suppressors because decomposition would then produce the metallic oxide rather than the metal. The case of bismuth alkyl compounds is cited, these decompose very easily giving the free metal, and when they are used in an internal combustion engine abnormally high pressures are developed but no detonation.

The action of aromatic amines as anti-knock materials is stated to be due to ease of oxidation of the radicles attached to the nitrogen atom. The action of iodine is explained as being due to its action as an oxidation catalyst.

The authors state that such theories and explanations apply only to knock suppressors, and not to knock inducers. W. N. H.

256. Centrifugal Machines and Processes of Using. Sharples Speciality Co., Assrs. of Leo Dietritch Jones and Arthur Underwood Ayres. E.P. 233,327. Conv. (U.S.A.), May 1, 1924.

Describes a centrifuge provided with means, such as pumps, for controlling the conditions of the atmosphere within the machine, and so to control the condition of the substance being treated by the application of pressure or vacuum. G. S.

Analysis and Testing.

257. A Test for Relative Decolorising Efficiencies of Clays. J. B. Hill, L. W. Nichols and H. C. Cowles, jun. *Ind. Eng. Chem.*, 1925, **17**, 818—819.

The test is made as follows: Four grams of the clay to be tested are added to 100 c.c. of the standard methylene blue solution at 90°F in an 8-ounce bottle and shaken for exactly ten minutes at roughly 100—200 shakes per

minute. The dye solution is quickly decanted into a suitable centrifuge tube and centrifuged for 10 minutes. The clear solution obtained is poured into a 4-ounce oil sample bottle and matched against a set of standards, the test being reported as the number of the standard which matches the test. Details for the preparation of the set of standards are given. S. F. B.

258. Copper Covers for Calorimeter Jackets. W. P. White. *J. Amer. Chem. Soc.*, 1926, **48**, 1149.

It is generally recognised that for accurate calorimetric determinations it is necessary that there should be uniform temperature conditions surrounding the calorimeter. Apart from the submarine and water-cap methods of inclosure it is usually the practice to surround the calorimeter with a water jacket, fitting the top with a cover of wood or rubber. While this diminishes the effect of room temperature variations, such covers have a considerable lag, so that their temperature is uncertain and not always constant.

The author therefore uses a cover made of sheet copper 0·8 mm. thick, drilled to take thermometers and stirring gear, and bent down around the edge to dip into the jacket water. Results of temperature variation under various conditions are given. S. B.

259. Apparatus for the Analysis of Small Amounts of Vapour when present in Permanent Gases. I. R. McHaffie. *J. Amer. Chem. Soc.*, 1926, **48**, 1143.

The apparatus was originally devised for the measurement of water vapour in air, but can be employed for other vapours and gases when the amount of vapour present need not exceed 0·5 mg. and an accuracy of 1 in 1000 required. One limb of a U tube with a capacity of 30c.c. is joined to a special tap, capable of holding a vacuum at a temperature of 40°C. The other limb is connected to a mercury manometer, to the bottom of which is sealed a glass tube 78 cm. long, sealed to a mercury air-trap and reservoir. The top of the manometer is fitted with a two-way cock leading to a mercury diffusion pump and aspirator, or other gas-measuring instrument, respectively. The whole apparatus is mounted in an air thermostat fitted with plate glass windows. An experimental determination of the dissociation pressure of sodium sulphate decahydrate showed the method to be capable of extremely accurate results. S. B.

260. Methods of Testing Natural Gas for Volume and Gasoline Content. George E. Lusk. *Oil Age*, 1926, XXIII (5), 35—37.

For the purpose of obtaining information as to the volume of gas being discharged from a well, an Orifice Well Tester or a Pitot Tube is used. The former consists of a 2 in. brass nipple, against the discharge end of which an orifice plate is held by a cap. About an inch from the orifice end of the nipple, a quarter-inch nipple is attached, and this connects to a U-tube manometer. This tester is adequate for wells up to 300,000 cu. ft. per 24 hours. For large wells a Pitot Tube is used. This consists of two small diameter brass tubes, angled to 90°, one of which can be inserted into the other with space to spare. The outer tube is tapered and the inner protruded about one inch beyond the point, the two being welded together, and a number of small holes drilled in the outer tube about three inches from the end. The other ends of the tubes are connected to the manometer. The contact end of the tube is held inside the gas discharge pipe, about one quarter diameter from the side. The inner

tube feels the impact or dynamic pressure of the gas and the outer the static pressure exerted from the sides of the pipe. The differential pressure is read on the manometer and the volume of gas calculated.

For gasoline content the Newlin Test may be used, and in this the gas passes at a known speed through an orifice and a measured quantity of mineral seal oil, which absorbs the gasoline. In the charcoal test, gas at a constant rate of flow is led to an upright charcoal cylinder. When the charcoal is nearly saturated the cylinder is plugged and taken to the laboratory, where it is tested and the gasoline content computed. G. S.

261. Rapid Method of Determining Iodine Value with Iodine and Alcohol. W. Austen. *Pharm. Zentr.*, **67**, (14).

In carrying out the determination of iodine by the method of Margosch, Hinner and Friedmann it is of importance that 200 c.c. of distilled water be added to the fat solution, and the minimum time of contact must be 6 minutes. Observing these precautions lard, beef, tallow and linseed oil gave iodine values of 58, 35·5 and 172·8 respectively, against the Hübl values of 58, 36·4 and 173·4. H. M.

262. Determination of Unsaturated, Aromatic, Naphthene, and Paraffin Hydrocarbons in Motor Fuels, and Their Automotive Equivalents. G. Egloff and J. C. Morrell. *Ind. Eng. Chem.*, 1926, **18**, 354—356.

The fuel is topped to 210°C. The distillate is treated with twice its volume of 80% sulphuric acid for 15 mins. The decrease in volume of the oil give the percentage of unsaturated hydrocarbons which have become dissolved in the acid layer. The oil is now washed, dried, and again topped to 210°C. The residue is calculated as a percentage on the first 210°C. fraction, and gives the unsaturated hydrocarbons which have been polymerised during treatment with the acid. A portion of the second 210°C. distillate is nitrated by means of 2½ times its volume of a solution containing 25 per cent. nitric acid and 58 per cent. sulphuric acid, the operation requiring 15—60 mins. Three layers are formed; from the volume of the intermediate layer of nitro-compounds the percentage of aromatic hydrocarbons is calculated (if the original volume of fuel was 500 c.c., and 20 c.c. of second distillate were taken, vol. of nitro-compounds × 4·3 = % aromatics in second 210°C. distillate). The oil layer is washed and dried, and the naphthene hydrocarbons determined by the aniline cloud point method (Tizard and Marshall, *J. Soc. Chem. Ind.*, 1921, **40**, 20 I). Paraffin hydrocarbons are found by difference. The properties of various fuels are expressed in terms of the artificial petrol-benzol blends to which they are equivalent in respect of the maximum spark-advance, which can be usefully employed with an engine running on the fuels or blends. W. S. N.

Refining.

263. Increasing Internal Volume of Silica Gels by Moist Heat Treatment. H. N. Holmes, R. W. Sullivan, and N. W. Metcalf. *Ind. Eng. Chem.*, 1926, **18**, 386-388.

The authors have compared the adsorptive capacities, for the vapours of various organic compounds, of silica gel prepared by three methods. (1) Solutions of sodium silicate and hydrochloric acid are mixed and the precipitate washed, dried and activated. (2) Solutions of sodium silicate and ferric chloride are mixed and the precipitate (ferric oxide and silica) dried and treated with hydrochloric acid. (3) Solutions of sodium silicate and ferric

chloride are mixed; the precipitate is collected, drained, and allowed to dry until the water content falls to 60 per cent. The material is then bottled and allowed to "sweat" for at least a week; it is then boiled with 6 *N* or 9 *N* sulphuric acid, washed, dried at 150° C. for eight hours, and activated at 140°C. to 200° C. in a current of dry air.

The adsorptive power of the three gels increases in the order given; a great increase in efficiency is brought about by the "sweating" process.

W. S. N.

264. Emulsification of Sodium Stearate and Palmitate. N. A. Jajnik and Bakhsh Ilahi. Kolloid—Z., 1925, **37**, 139-144.

The authors have compared the emulsifying powers of sodium stearate and palmitate by determining the least quantity of soap that will just emulsify definite volumes of certain oils. As the purity of the soaps considerably influenced their emulsifying powers, they were carefully prepared by neutralisation of a solution of the acid in alcohol with sodium carbonate, evaporation to dryness and extraction of the dried mass with alcohol. It was found that sodium palmitate generally possessed greater emulsifying power than sodium stearate, and that the soap solution having the lowest surface tension was the best emulsifying agent. Emulsifying power also increased with concentration of the soap solution.

S. F. B.

265. Improvements in Refining Hydrocarbons. J. Y. Johnson and Bad. Anil. und Soda Fabrik. E.P. 249,309, 1925.

Hydrocarbon distillates, cracked oils, low- and high-temperature tars and the like are refined by distillation with non-superheated steam in presence of an alkaline or alkaline earth-metal hydroxide. The product may be subsequently treated with hydrogen in presence of a finely divided metal at a moderately elevated temperature.

H. G. S.

266. Gasoline Recovery. F. E. Hosmer. U.S.P. 1,381,212. 20.4.26. Appl. 14.5.20.

A mixture of permanent gas and condensible vapour is enriched with a further quantity of condensible vapour, compressed and cooled. By evaporation of a portion of the condensed liquid the inlet gases are cooled by heat transfer, the evaporated vapours being returned to the compressor with the fresh gases.

S. B.

267. Recovery of Metallic Halides from Hydrocarbon Sludges. P. S. Danner. Assr. to Standard Oil Co. U.S.P. 1,582,131. 27.4.26. Appl. 19.5.25.

The sludge produced during the conversion of hydrocarbons in the presence of metallic halides is subjected to simultaneous cracking, and hydrogenation whereby lighter saturated hydrocarbons are formed, and the metallic halide liberated for further use.

S. B.

268. Adsorption Silicious Material, Preparation of. Francis Xavier Govers. E.P. 243,123.

A process is claimed for the preparation of adsorbtive silicious material, and consists of the drying of a "sol" produced by the precipitation of silicic acid prior to the forming of a "gel." Iron, silver, platinum or other catalysts, in a colloidal form, may be added to the colloidal silicic acid.

G. S.

269. HIGHLY ACTIVE CHARCOAL, MAKING OF IN GRAINS. Gesellschaft für Chemische Producktion m.b.H., Hellmuth Müller-Clemen and Irwin Schmidt. E.P. 224,521. Conv. (Germany) 5.11.23.

A process is claimed for the manufacture of highly active carbon in a pulverulent form. Wood or other suitable vegetable matter, in granular form, is impregnated with potassium sulphide or liver of sulphur, in the presence or absence of carbonate of potash, and finally calcined with exclusion of air. G. S.

270. REFINING HYDROCARBON OILS, MATERIALS FOR. Röy Cross. E.P. 227,084. Conv. (U.S.A.) 31.12.23.

Gasoline and other light hydrocarbons of a low-boiling point are claimed to be deodourised, decolourised and desulphurised by the use of hydrous aluminium silicate combined or mixed with a metal salt. The treatment can be successfully applied while the hydrocarbon is in the vapour phase. G. S.

271. PROCESS OF DEHYDRATING OIL. H. C. Eddy. Assr. to Petroleum Rectifying Co. of California. U.S.P. 1,580,591 of April 13. Appl. Aug. 26, 1924.

Water and solid impurities are separated from an oil emulsion by treating it to agglomerate the fine water particles, allowing the liquid to stratify and removing the driest portion. A wetter portion is passed through a water bath to wash out water and suspended impurities, and the supernatant oil removed. H. M.

272. PROCESS OF DESULPHURISING PETROLEUM OILS. J. B. Rather. Assr. to Standard Oil Co. of New York. U.S.P. 1,580,531 of April 13. Appl. May 9, 1923.

Hydrogen sulphide gas is dissolved in the oil, which is then combined with a mixture of sodium hydroxide and litharge, or sodium plumbite, producing lead sulphide suspended in the oil. The lead sulphide promotes reaction between the sulphur compounds of the oil and the plumbite solution, rendering the oil sweet to doctor test and non-corrosive. H. M.

273. TREATING APPARATUS FOR CRUDE OIL. H. L. Edwards. U.S.P. 1,578,273 of March 30. Appl. March 29, 1924.

A dehydrating apparatus in which a horizontal pipe contains heating sections, closed transversely, but transversed by oil tubes longitudinally, serves as a conduit for the oil. Heating fluid is supplied by a pipe to the sections. Intermediate sections are unobstructed and allow settling out of the water, for which outlets are provided. H. M.

274. THE ADSORPTION OF ASPHALT FROM MINERAL OILS OR RESIDUES BY HYDROSILICATE BLEACHING EARTHS. H. Herbst. *Petroleum*, 1926, 22, 424.

On diluting 1,000 g. of illuminating oil residue with 250 g. of kerosene the mixture was found to have an asphalt content of 8 per cent. The mixture was filtered through a layer of "Silit" 15 cm. thick, weighing 580 g., consisting of equal parts of powdered and granular material, at a temperature of 60° C. The filtrate commenced to pass after forty-eight hours, and in further forty-eight hours amounted to 95 g.; was light yellow and free from asphalt. A

second fraction of 65 g. was dark yellow and free from asphalt. After three days a third fraction of 150 g. was collected, dark in colour and containing 7·0 per cent. of asphalt. Thus the "Silit" was exhausted after adsorbing 2·5 per cent. only of its weight of asphalt, and would then require regenerating, a troublesome process. The first fraction of filtrate was found to be slightly lower in specific gravity than the succeeding fractions. H. M.

275. Treatment of Hydrocarbons. E. Goltstein. (E.P. 249,895 of Sept. 30, 1924.)

Petroleum and similar hydrocarbons are subjected to the action of light of short wave-length such as is obtained by the use of a mercury vapour lamp. The treatment may be applied to either the liquid or vapour phase during distillation, the effect being polymerisation and consequent change in the physical characteristics of the distillates. S. B.

276. Electrical Dehydrator. D. K. Cason, Jun. (U.S.P. 1,579,515 of April 6, 1926. Appl., Aug. 16, 1924.)

The apparatus consists of a series of cone-shaped plates spaced apart by gradually increasing distances from top to bottom. Alternate plates are earthed and the intervening ones connected to a high-tension circuit.

S. B.

277. Treatment of Acid Tar. R. A. Halloran, W. N. Davis, and G. A. Davidson. Assrs. to Standard Oil Co. (U.S.P. 1,579,607 of April 6, 1926. Appl., Sept. 6, 1923.)

The acid tar resulting from the treatment of petroleum with sulphuric acid is heated under pressure of 50 lbs. per sq. in. either with or without the addition of fuel oil. Separation into clean weak acid and an oil suitable for fuel is obtained. S. B.

278. De-emulsification of Oils, etc. C. V. Zoul (Celite Company). (U.S.P. 1,569,695 of Jan. 12, 1926. Appl., Jan. 30, 1923.)

An apparatus is claimed for separating emulsions, particularly crude oil emulsions, which may, if desirable, be subjected to a preliminary heating and settling process. The emulsion, preheated, if necessary, to 120°—160° F., is passed through a filter press, on the cloths of which a porous material, preferably diatomaceous earth, has previously been deposited by circulating through it a suspension of the porous material in a heated, dry medium, preferably similar to the non-aqueous constituent of the emulsion to be treated. The emulsion is broken by its passage through the absorbent material, perhaps by removal of the emulsifying agent; the constituents are then separated by gravity settling. W. S. N.

279. Siliceous Alkaline-earth Product. R. Calvert (Celite Co.). (U.S.P. 1,574,363 of Feb. 23, 1926. Appl., Jan. 12, 1923.)

A filtering, decolourising, and purifying material is prepared by boiling diatomaceous earth with aqueous lime solution. At least 275 lb. water per 10 lb. lime is preferred; the lime is from 30% to 100%, by weight, of the siliceous earth. The product may be employed wet, or it may previously be dried. W. S. N.

280. Manufacture of Highly-active Decolorising Charcoal. H. Müller-Clemm (Gesellschaft für Chemische Produktion M.B.H.). (U.S.P. 1,575,703 of March 9, 1926. Appl., May 2, 1924.)

In the process of producing active charcoal by calcining carbonaceous material which has been previously impregnated with a mineral substance (*e.g.*, potash or zinc chloride) instead of an alkali, an alkali sulphide is employed. In dealing with material which has been precipitated by means of lime from sulphite cellulose waste lye, excess of lime is removed by means of carbon dioxide after an alkali sulphide has been added, the filtered liquid is evaporated and the residue is carbonised in the absence of air. W. S. N.

281. Finely-divided Calcium Metasilicate. H. A. Endres (Celite Co.). (U.S.P. 1,574,380 of Feb. 23, 1926. Appl., June 23, 1925; *cf.* U.S.P. 1,574,363.)

Diatomaceous earth is boiled with an excess of aqueous lime solution, the mixture is filtered, and the wet product is calcined at 1000°—1600° F. in the presence of carbon dioxide. The product consists of hydrated calcium metasilicate, $CaO{\cdot}SiO_2{\cdot}\frac{1}{2}H_2O$, and calcium carbonate, and is useful, amongst other things, as a medium for filtration or demulsification. W. S. N.

282. Decolourising and Defecating Product. G. J. Esselen, Jun. (United Fruit Co.). (U.S.P. 1,575,561 of March 2, 1926. Appl., Oct. 6, 1922.)

Sugar cane pith, substantially isolated from the fibrous component of the cane, is mixed with lime and water to a paste, which is then warmed to 80°—100° C. It is preferred to use 4 parts of pith to one of lime. The lime-cellulose mixture, after a preliminary drying, is carbonised, preferably in two stages, the final temperature (800°—900° C.) being sufficient to partly causticise the lime, which becomes converted to carbonate during the earlier stage of heating. The product (which may contain, for example: calcium carbonate 71%; free lime, calculated as hydroxide, 14%; carbon 15%) is a decolourising and defecating material which has the useful advantage of automatically neutralising any free acid present in the material to be decolourised. In using this product for decolourising sugar solutions the free lime is neutralised with phosphoric acid. After use with an aqueous solution the material may be revivified by washing and heating to 800° C. or higher. W. S. N.

283. Dehydrating [and Distilling] Emulsions. W. Cameron (Simplex Refining Co.). (U.S.P. 1,580,956 of April 13, 1926. Appl., Nov. 15, 1920.)

An oil containing saline water is dehydrated by injecting it into the vapour space above a body of heated oil which has already been dehydrated, and which is maintained at a temperature above the boiling point of water by circulating it through the vapourisation chamber and through heating coils. Oil vapour and steam, and dehydrated oil containing salts in suspension, are withdrawn continuously. It is stated that the formation of saline crusts (due to contact between the aqueous saline phase and heated metallic surfaces) is thus avoided. W. S. N.

284. Desulphurising Petroleum Oils. J. B. Rather (Standard Oil Co.). (U.S.P. 1,580,531 of April 13, 1926. Appl., May 9, 1923.)

Lead sulphide, when produced in suspension in a petroleum oil, is capable of adsorbing objectionable sulphur compounds, which are thus withdrawn, leaving the oil sweet. Advantage is taken of this by dissolving hydrogen

sulphide in petroleum, and then agitating the latter with alkaline sodium plumbite solution. W. S. N.

285. Recovered Inorganic Filter Aid. H. S. Thatcher (Mesne Assignments). (U.S.P. 1,571,074 of Jan. 26, 1926. Appl., Jan. 24, 1923.)

Diatomaceous earth containing organic material and inorganic salts, *e.g.*, after use in the filtration of sugar solution, is recovered by drying it, finely dividing it, and then calcining the dried and finely disintegrated material at a temperature (*e.g.*, *ca* 1800° F.) sufficiently high to remove part of the inorganic impurities. To facilitate the removal of inorganic substances, a salt of an alkali metal may be added previous to calcining. W. S. N.

286. Treating Filtration Residues for Re-use. P. A. Boeck (Celite Co.). U.S.P. 1,571,042 of Jan. 26, 1926 (Appl., Jan. 19, 1921).

Diatomaceous earth, containing organic impurities, lime and water (after use in the filtration of, *e.g.*, sugar solution), is recovered by drying, disintegrating, and then heating at a temperature and for a time sufficient to remove the organic impurities and free, absorbed, or adsorbed, water, but insufficient to remove water which is chemically combined with the diatomaceous earth. Fluxing action between the siliceous earth and the admixed lime, which occurs at a somewhat higher temperature than that at which combined water is driven off, is thus avoided. In this way the porosity of the diatomaceous earth is retained. W. S. N.

287. Treating Apparatus for Crude Oil [Continuous De-Emulsification]. H. L. Edwards (G. H. L. Kent and R. Richmond). U.S.P. 1,578,273 of March 30, 1926 (Appl., March 29, 1924).

Crude oil requiring de-emulsification and dehydrating is passed through a horizontal pipe composed of alternate heating and settling sections. The flow is more restricted through the heating sections, which consist of an outer vessel through which heating fluid (steam) is passed and a series of longitudinal tubes which carry the oil. The settling sections are provided with means for taking off the separated water and sludge. By means of a valve at the exit end of the apparatus, the oil within the tube may be subjected to increased pressure; this is said to help in breaking particularly obstinate emulsions. Thermostatic heat control is provided. W. S. N.

288. Extracting Vanadium from Petroleum Hydrocarbons. A. Oberto. U.S.P. 1,570,170.

Suitable petroleum material, such as still residue is heated strongly to remove volatile constituents and the residue extracted with a solvent (*e.g.*, water) and steam to extract the soluble vanadium compounds. S. F. B.

289. Treating Bituminous Substances to Remove Sulphur. G. W. Acheson. U.S.P. 1,570,193.

The bituminous substance (*e.g.*, crude sulphur containing oil) is treated with a reflocculated solid adsorbent material. A sulphur containing precipitate is separated from the oil. A suitable material is reflocculated clay and sulphuric acid. S. F. B.

290. TUBE STILL. J. M. Sims and O. M. Brooks. U.S.P. 1,581,879 of April 20, 1926 (Appl., Oct. 24, 1924).

The still consists of a coil-heating chamber formed of bolted steel tubes lined with clay material and a continuous coil formed from a series of tubes extending across the heating chamber. The bends of this coil project through the walls and are removable. S. B.

291. DEPHLEGMATOR. G. Egloff and H. P. Benner, Assrs. to Universal Oil Products Co. U.S.P. 1,582,588 of April 27, 1926 (Appl., May 2, 1921).

The column contains a number of vertically spaced perforated plates, the distance between which is adjustable. S. B.

292. PROCESS AND APPARATUS FOR DISTILLING PETROLEUM OILS AND OTHER LIQUIDS UNDER HIGH VACUUM. Zieley Processes Corp. E.P. 248,513 of Dec. 24, 1924.

The process is adapted for the distillation of the heavier fractions of petroleum to produce lubricating oils of saleable quality without subsequent refining. The oil moves downwards through inclined conduits in a shallow stream under a pressure of 50 mm. of mercury or less, being subjected to increasing degrees of heat. The instantaneous evaporation of the oil and the free egress of the vapours prevent cracking or coking in the conduit. A header supplies oil to the conduits, further headers are separate, connected to separating towers and thence to a series of fractional condensers, jacketed for a cooling medium. The condensers are connected to duplicate receiving tanks, which may be alternately withdrawn from the circuit and emptied. To facilitate the removal of vapour each conduit is provided with an internal conduit perforated with small holes, which allow the passage of oil or vapour, but tend to break up froth or "spew" formed in the evaporation of the oil. The ends of the internal conduit may be partially closed by plugs. The vacuum pump is preferably of the ejector type, which requires no oil seal or lubrication. The vapour outlets throughout the system are of large capacity, and intercommunicate, to promote equalisation of the pressure. H. M.

293. APPARATUS FOR DISTILLING HYDROCARBONS. N. F. W. Hazeldine. U.S.P. 1,580,372 of April 13, (Appl., May 9, 1922).

A tank is divided by a horizontal partition into chambers, and an inner shell within the upper chamber spaced apart from the walls provides a jacket for cooling fluid. A riser extends upward from an opening in the partition and projects through the bottom wall of the inner shell. Liquid may be drawn from this shell at a point beneath the outlet opening of the riser. H. M.

294. HEATING SYSTEM FOR OIL STILLS. F. E. Wellman, Assr. to Kansas City Gasoline Co. U.S.P. 1,576,563 of 16th March. (Appl. 17th December, 1921).

Between a vertical still and its furnace setting there is an annular combustion space, from the upper part of which the products of combustion pass to a stack. Means are provided for producing localised combustion in the lower part of the annular space, and for constantly changing the point of application of the resultant flame to the still wall. H. M.

295. Heating Material at Successively Different Temperatures. A. McD. Duckham and J. S. Morgan (Thermal Industrial and Chemical Research Company, Ltd.). U.S.P. 1,568,886 of Jan. 5, 1926 (Appl., Aug. 9, 1921).

Fractional vapourisation or fractional destructive distillation of the constituents of a solid or liquid material is effected by passing the material between the surface of a molten metal, *e.g.*, lead, and a solid surface immersed in the metal, removing the vapourised constituent, and so treating the residue again, in such a way that the material is raised to successively higher temperatures. This is brought about either by the use of baths of metal of successively higher temperatures (all of which may, however, be heated from a common flue system), or by the use of a common bath of uniformly heated metal, the speed of passage of the material being gradually decreased at successive immersions. In either form of apparatus the immersed surfaces are those of rotating drums (contained within a series of stills), which serve also as a means of propulsion for the material. W. S. N.

296. Distillation of Crude Petroleum. E. M. Clark (Standard Development Co.). U.S.P. 1,582,123 of April 27, 1926 (Appl., July 3, 1919.)

A pitch of m.p. at least 320° F., representing about 4 per cent. by volume of the original crude oil, is produced by distilling the latter in a series of continuous stills in which distillation is effected below cracking temperature by the aid of injected steam (as well as external heating). W. S. N.

297. Oil-Heating Furnace. J. E. Bell (Sinclair Refining Co.). U.S.P. 1,574,546 of Feb. 23, 1926 (Appl., Jan. 28, 1922).

In a tubular oil still the heat absorbing surface is protected from the direct radiation of the furnace by the interposition of a brick partition and a vertical flue with refractory walls. Further, dilution of the hot furnace gases is employed, either by returning part of the waste gases from the still or by introducing air which has been preheated by means of the waste still gases. W. S. N.

298. Operation of Oil Stills. J. E. Bell (Sinclair Refining Co.). U.S.P. 1,574,547 of Feb. 23, 1926 (Appl., Aug. 10, 1923).

Cf., oil-heating furnaces, Bell (U.S.P. 1,574,546). The process of operation of furnaces designed according to U.S.P. 1,574,546 is claimed. W. S. N.

299. Still. J. Young. U.S.P. 1,584,267 of 1926 (Appl., Jan. 17, 1922).

An apparatus for the fractionation of liquids consists of a still provided with a condenser which comprises an upwardly inclined tubular chamber provided with baffle plates extending alternately from the upper and lower walls. The baffle plates extending downwards are imperforate and those extending upwards are perforated. The condenser, which is surrounded with a jacket for cooling purposes, is connected with a second and downwardly inclined condenser for condensation of the more volatile vapours. H. G. S.

300. Apparatus for Refining Oils. D. Pyzel. U.S.P. 1,583,746 of 1926 (Appl., Oct. 26, 1921).

Oil to be distilled or cracked is pumped through coils placed in a furnace and is delivered into the top of a still fitted with spreader cones. The residuum oil condensed there is drawn off to storage, whilst vapours pass on to

the bottom of a dephlegmator, into the top of which the crude oil is admitted. The remaining vapours are then taken through a condenser, whilst the hot crude is drawn off at the bottom and pumped through the circuit. A cooler may be inserted to augment the efficiency of the dephlegmator. H. G. S.

Lubricating Oil and Wax.

301. Diesel Engine Lubrication. P. L. Scott. *Ind. Eng. Chem.*, 1926, **18**, 477—480.

The demands of the oil engine for steady running at full load, as regards lubrication, are much more severe than on an automobile; yet it is expected that the Diesel should use much less oil than the latter type of engine.

The successful lubrication of Diesel engines has been found to depend on four factors:—(1) Efficient supply of the correct lubricant. (2) Moderation in bearing loads. (3) An adequate oil purifying system. (4) Thorough supervision during operation. Of these, the first three are problems for the engineer and oil chemist, the fourth being entirely to do with the user of the engine.

The lubricating difficulties generally experienced are usually due to the failure of the moving parts to get oil, or failure of the actual oil film owing to imperfect design, unsuitable oil or dirt.

The value of a clean oil is brought out by two illustrations, and methods for accomplishing this are suggested. S. F. B.

302. Automotive Engine Lubrication. A. W. Pope, Jun. *Ind. Eng. Chem.*, 1926, **18**, 490—492.

The modern practice of lubrication in automobile engines is reviewed. The splash system, which is the most widely used to-day, has many advantages but, because of certain short comings, is gradually being replaced by the pressure system for heavy-duty high-speed work. It possesses certain very desirable features, for the engine is always filled with a uniform, concentrated, heavy oil mist which permeates all spaces open to the crank case. Corrosion is also minimised by this type of lubrication, which tends to eliminate the rust-producing substances in the oil.

The weakness of the splash system lies in its inability to create a hydraulic oil pressure within a rotating bearing, which is great enough to prevent metal-to-metal contacts of the surfaces under heavy loads or with large clearances. As a result, using a splash system, it is necessary to keep close bearing clearances in order to maintain quietness: in consequence, only a slight amount of play, due to wear, is required to make a noisy engine. Although these difficulties are partly eliminated by a pressure oil-feed system, this system has its limitations. The chief failing lies in non-uniformity of flow, through bearings being of varying clearances and also because of varying viscosity in the oil. This produces an irregular condition of lubrication for parts which are dependent upon the splash from the overflow of pressure-lubricated bearings. No fine mist exists in the crank case as with a splash system, the crank case atmosphere being permeated with large drops and globules of oil instead. The result of these considerations is that the trend of automotive lubrication is towards a combined splash-pressure system in which are incorporated the good points of both. The one part of an engine which is extremely difficult to lubricate is the piston and upper piston rings. The upper piston ring moves on the cylinder wall at speeds higher than 2,000 ft. per minute with a gas pressure of 300—500 pounds per square inch forcing it against the cylinder, and with the lubricating oil, contaminated

with carbon particles as well as the heavy ends from the fuel, at 200—300° F. As, too, the oil on the cylinder wall is exposed to a temperature of roughly 2,000° F. at every forcing stroke, it can be seen that the conditions of operation are very severe. The methods at present employed to lubricate these parts generally cause "oil-pumping" or as it is wrongly diagnosed "over-lubrication." Two methods are used to cure this, the one being to starve the engine of oil and the other to use very closely fitting piston rings. Both of these conditions are undesirable and it was with a view to bettering the lubrication of these parts that the fresh oil or side-wall lubrication system was developed. This consists of a reciprocating pump which feeds fresh oil from the oil tank into a groove in the cylinder wall just below the upper ring at the bottom of its stroke. The result is that wear on the piston, rings and cylinder is greatly reduced by this system. Oil purification by elimination of solids from the oil and control of dilution is also discussed and the need for an oil which will permit an engine to be turned over freely at —20° F. emphasised. S. F. B.

303. Oil Flow in Plain Bearings. D. P. Barnard. *Ind. Eng. Chem.*, 1926, **18**, 460—467.

An attempt is made to present the fundamental laws of fluid lubrication in such a manner that they may be used for the correlation of test data. A simple development of the approximate laws governing the flow of oil through bearings, due to the pressure from the journal and also to oil feed pressure, is described. Experimental data is given in substantiation of the method. S. F. B.

304. Motor Carbon Deposits Formed under Controlled Conditions from Typical Automobile Oils. C. J. Livingstone, S. P. Marley and W. A. Gruse. *Ing. Eng. Chem.*, 1926, **18**, 502—504.

Difficulty is always experienced in obtaining reliable results when using a gasoline engine, owing to the fact that an engine is not a precision instrument, and consequently duplication of results, particularly as regards carbon deposits, is practically impossible. With a view to examining the deposit of carbon in an engine running under conditions as nearly constant as possible, the authors have designed an engine in which all variables, with the exception of one, the lubricating oil, are fixed. This consisted of a single cylinder motor having a special lubricating system permitting the circulation of a very small charge of lubricating oil. Devices were also fitted which enabled the head, the oil and intake temperatures, the amount of fuel, the load and the speed to be closely controlled. It was found with this engine that the weight of carbon deposited from a definite oil in a fixed time was always the same. Tables are given of carbon deposited by various oils when used in the engine under standard conditions. It appears from these results that the differences in the deposits obtained from different oils are real and significant and are determined by the oil. S. F. B.

305. Characteristics of Full and Partial Journal Bearings. H. A. S. Howarth. *Ing. Eng. Chem.*, 1926, **18**, 453—460.

An analysis has been made of the characteristics of various types of bearings, based upon the hydrodynamical theory of lubrication originated by Reynolds and elaborated by Harrison. In these analyses, which are graphical, and therefore developments of Reynolds two-dimensional theory,

side leakage is left out of account, and the viscosity of the oil is assumed to be constant throughout the film. The influence of friction upon the direction of the resultant force of the oil film upon the bearing surfaces, is also neglected in the examination of partial bearings because of its relative insignificance for practical purposes. The types of bearings to which the analysis has been applied are as follows :—(1) Bearings bored with running clearance. (*a*) Full or complete bearings. (*b*) Central partial bearings in which the line of action of the resultant load bisects the bearing angle. (*c*) Offset partial bearings in which the line of action of the resultant load intersects the bearing surface usually more than half way from the leading edge. (2) Bearings fitted carefully to the journal. As no running clearance is provided these bearings must be less than 180° long in order to function. The graphical analyses of these bearings have provided a number of fundamental laws which govern the actual lubrication of all plain journal bearings. The bearing characteristics given represent ideal conditions in that they show the maximum film thickness which may be realised for a given load. Although it is not possible to apply these laws exactly to actual bearings in which such factors as end leakage and surface roughness play a modifying part, they serve as a very useful guide in indicating the actual carrying powers of the bearings. As an example of the use of these laws the question is cited, whether it is better to employ two or more pivoted segments to support a journal instead of a single partial bearing. It can readily be shown that the film is thinner when the bearing is composed of two segments, the total arc of each bearing and other conditions being equal. By similar reasoning it can be shown that a three-segment bearing is inferior to one of two segments. It is quite possible that many bearing problems may be solved approximately by the graphical methods once its usefulness and limitationsare understood. S. F. B.

306. The Rôle of Oiliness in Industrial Lubrication. W. C. Wilharm. *Ind. Eng. Chem.*, 1926, **18**, 463—470.

Bearings when well designed and lubricated run chiefly on fluid films of the lubricant. These films are quite appreciable in thickness, and as most of the friction is borne entirely by them, a low viscosity oil is more economical in power consumption than is one of higher viscosity. Yet, although it is ideal for all the weight to be taken by the oil film, no bearing can run entirely on this film, for the liquid film is often broken and damage is done by actual metal-to-metal rubbing, this nearly always happening when starting and stopping. For this reason oils of higher viscosity are actually used, as the film-forming tendencies are chiefly a function of speed, viscosity and load. It is when the film ruptures that the oiliness becomes an important factor, helping the two surfaces to rub over each other smoothly. The nature of oiliness is not at all understood. It has been defined as that property of lubricants by which one fluid gives lower co-efficients of friction than another having the same viscosity, generally at low speeds or high loads. The following points regarding oiliness are now generally accepted :—(1) It is a property of lubricants other than its viscosity which is of considerable economic importance. (2) It is a function of the chemical constitution of lubricants. (3) It is generally attributed to an adsorbed film on the surfaces of the bearings. Various methods for measuring the oiliness have been described, but the simplest and most effective method seems to be a measurement of the static friction under relatively high pressures. The authors have therefore used a modified inclined plane in an attempt to measure the oiliness of certain oils. This apparatus consisted of an inclined brass plane with a steel ball slider carefully insulated from shocks and vibrations, and the initial motion of the

slider was detected by an electrical arrangement, capable of detecting a movement of 0·001 of an inch. With this apparatus it was found that fairly concordant results could be obtained from any one oil. On testing various oils it became evident that they differed from each other considerably, although no difference was shown by ordinary tests. Also a comparison of a Pennsylvanian crude with a lubricating oil fraction showed that the process of refining was not detrimental to the oiliness property of the oil. Deductions are drawn from the results of the tests made and are discussed. S. F. B.

307. Power and the Viscosity of Oil. William F. Parrish. *Ind. Eng. Chem.*, 1926, **18**, 525—526

An account of tests carried out in 1910 in Germany to show the advantages of a specially refined and finished oil for lubricating plant over one blended from heavy and light oils to give the same viscosity. The tests were made on a ring spinning machine and also on a cotton twisting machine in a cotton mill, and it was found that the specially prepared oil (American) changed only slightly in viscosity, colour and acidity, even after a considerable period of use, whereas the blended oils (Russian) had become gummy, their acidities and viscosities had considerably increased. The increased viscosity caused considerable loss in power in plant lubricated with the blended oils.

S. F. B.

308. A Possible Test for the Oiliness of Oils. Augustus H. Gill and Helen Gill. *Ind. Eng. Chem.*, 1926, **18**, 527.

The authors suggest that a modification of Perrott's method (*Bur. Mines Bull.*, **192**) for determining the nature of carbon black by mixing it with certain oils and examining its behaviour in the MacMichael viscometer, might prove useful in comparing the oiliness of oils. The procedure is as follows:—The deflection of the oil by itself is first measured in degrees MacMichael at four to six different speeds of rotation, ranging from 5 to 80 revolutions per minute at 25° C. Ten grams of well-ignited infusorial earth are then mixed with 100 c.c.o. of the same oil, and the deflection for the suspension found as before. The figures obtained are plotted, with degrees MacMichael as ordinates and revolutions per minute as abscissæ. The difference between the two straight lines obtained at 70 revs. per minutes is read in degrees MacMichael, and can be readily converted into centipoises by means of a similar graph made with solutions of glycerol of known viscosity. Results obtained using various oils are tabulated and appear to agree well in order with the known lubricating qualities of the oils. S. F. B.

309. A Problem in Diesel Engine Lubrication. F. Norton and R. R. Matthews. *Ind. Eng. Chem.*, 1926, **18**, 480—481.

A description of the steps taken to correct the lubrication of an existing plant of five Diesel engines which lost considerable running time owing to imperfect lubrication. It was found that an oil of much lower viscosity than that generally used for these engines, gave excellent results, although such an oil had previously been considered dangerous. The type of oil finally adopted was one that could be prepared from any large American oilfield. It had a viscosity (Saybolt) of 300—500 at 100° F., although the type of oil generally employed by Diesel engine users has a viscosity (Saybolt) of 500—750 at 100° F. or higher. S. F. B.

310. Refining Lubricating Oil Stocks. J. W. Weir. U.S.P. 1,581,369 of April 20, 1926 (Appl., May 14, 1925).

Lubricating oil stock is treated with sulphuric acid and the sludge removed, as far as possible, after settling. Comminuted solid adsorbent is added and the mixture agitated at a temperature below the decomposition temperature of the sludge; the adsorbent is then removed. A further quantity of adsorbent is now added and agitation is carried out at a temperature (at least 180° F., preferably 360° F.) sufficient to decompose the remaining sludge and to liberate sulphur dioxide (which may be removed by the passage of a non-oxidising gas); whilst the mixture is still under agitation litharge is added to remove objectionable sulphur compounds. Blowing with a non-oxidising gas during the litharge treatment is optional. The purified oil is then removed from the adsorbent material. W. S. N.

311. Manufacturing Lubricating Oils. J. W. Weir. U.S.P. 1,581,370 of April 20, 1926 (Appl., Nov. 9, 1925).

Lubricating oil is treated with sulphuric acid, the sludge is removed, and the oil is then treated with an alkaline substance, in the usual way. In order to destroy the blue fluorescence which the oil now possesses, and to impart to it a green fluorescence, a second acid wash is employed. The sludge is allowed to settle and is separated as far as possible; remaining sludge in suspension is removed by two treatments with a finely divided solid absorbent (the first at the ordinary temperature, the second at 250° F. or preferably 300° F.), the absorbent being removed after each treatment. Finally the oil is brightened by air-blowing. W. S. N.

312. Purifying Oils, Methods of. British Thomson-Houston Co., Ltd. Assr. of Charles van Brunt. E.P. 235,861. Conv. (U.S.A.) June 23, 1924.

A process for removing suspended solid matter from oils, particularly used crank-case oil, is claimed, and consists of adding an oil-soluble metal resinate to the oil, coagulating the solid matter with water-glass and removing it by subsidence in water. G. S.

313. Penetrating Oil and Lubricant. H. N. Copthorne, Assr. to Illinois Graphite Co. U.S.P. 1,580,233 of April 13, (Appl., June 5, 1924.)

Deflocculated graphite is supended in a distillate of sp. gr. 0·843 at 60° F. obtained by cracking pentadecane at a distilling range of 220° C. to 350° C. H. M.

314. Removing Wax from Oil. H. F. Glair and O. E. Bransky (Standard Oil Co.). U.S.P. 1,582,923 of May 4, 1926 (Appl., July 7, 1922).

Wax is removed from light, wax-bearing, substantially uncracked oil distillates by adding a less viscous hydrocarbon oil (of the type which is heavier than burning oil), chilling, and filter-pressing the mixture. W. S. N.

315. Treating Lubricating Oils. E. G. Acheson. U.S.P. 1,584,588 of 1926 (Appl., March 19, 1921).

The quality of lubricating oils is improved by agitation with a mixture of acetone and water or the like solvent. The components of lesser lubricating value are thus removed. H. G. S.

Cracking.

316. The Holmes-Manley Cracking Process. *Petr. Times* **15**, 704.

In the Holmes-Manley Cracking Process oil is heated to full cracking temperature in preheating coils and is then directed into four vertical stills which

are set in a furnace with their upper and lower ends protruding. The heat to the stills is so regulated that the oil contained therein is at a comparatively low temperature, the time element being therefore relatively longer. Rotating scrapers in the stills remove deposited carbon, and cause it to gravitate to the cooler bottom below the heating zone.

The vapours produced are led to a bubble tower and dephlegmator, thence through a reflux condenser and finally through a water-cooled condenser to spirit storage. The condensate which collects in the bubble tower is pumped through the preheater and stills for further treatment, whilst the heavy bottoms from the stills are withdrawn into expansion drums and distilled, largely by contained heat.

Commercial runs have lasted for 60 days, the longest being 63 days. In this latter operation, 86,424 barrels of stock were run, giving 37·48 per cent. of naphtha, 59·58 per cent. of pressure bottoms, 4·45 per cent. of gas and 0·09 per cent. of coke.

Seventy-nine Holmes-Manley units were said to be in operation at the end of 1925. Twenty-four of these, built in 1920, are rated at 24,000 barrels per month, the remainder at from 30,000 to 34,000 barrels. During 1925, 20,910,497 barrels of oil were treated, yielding 8,235,955 barrels (39·39 per cent.) of gasoline and 66·11 per cent. of fresh or virgin gas oil. From 1920 to 1925, 67,639,538 barrels of oil have been cracked by the process. H. G. S.

317. Process for Obtaining a Light Hydrocarbon. W. Landes. U.S.P. 1,582,764 of 1926 (Appl., May 19, 1924).

The oil to be cracked is atomised with steam into a chamber and casing-head gas similarly atomised into the same vessel but at a lower level than the oil inlet. The vessel is maintained at atmospheric pressure. Vapours pass away through condensers and the residue is drawn off continuously. The temperature of the vapours is maintained at about 220° F. (105° C.) and of the residue at 150° C. H. G. S.

318. Apparatus for Treating Hydrocarbon Oils. C. P. Dubbs. U.S.P. 1,582,585 of 1926 (Appl., April 16, 1917. Renewed July 15, 1925).

Plant for the cracking of hydrocarbons by means of distillation under pressure consists of a series of stills, connected in series by appropriate pipes, each still being fitted with a dephlegmator upon which is superimposed an aerial condenser. The oil to be distilled is pumped in turn through the dephlegmator boxes, so that it becomes progressively hotter and at the same time assists in returning heavier vapours to the stills. It then enters the first still. The arrangement of pipes and valves described allows of various preheaters or condensers to be by-passed. Means may be provided for agitating the oil in the stills. The pressure, varying from 85 to 250 lbs. per square inch, is maintained in the stills and condensers. H. G. S.

319. Apparatus for Cracking Hydrocarbons. F. E. Wellman. U.S.P. 1,581,895 of 1926 (Appl., Feb. 12, 1926.

Oil to be cracked is circulated by means of a pump through a series of pipes arranged in pairs and heated in a furnace. Pressure is maintained at 300 lbs. per square inch, and when 50 per cent. of the volume of oil has passed out of the circuit as distillate the remainder is quickly blown out of the tubes, which are then ready for the next charge of oil. The tubes are arranged with a slight slope in the direction of the oil flow. H. G. S.

320. Cracking Process (Blending). J. T. Shevlin, Comm. by Universal Oil Products Co. E.P. 249,604 of Dec. 29, 1924.

An improvement on the Dubbs process, E.P. 160,236.

To obtain lighter products a heavy hydrocarbon oil is subjected to a cracking temperature in a heating coil, and thence passes to an expansion chamber and to a dephlegmator. The oil and condensate from the dephlegmator are returned to a cracking furnace, to which an independent quantity of charging stock may also be supplied. The pressure in the dephlegmator may be above atmospheric but below that in the cracking coil or conversion chamber. More than one dephlegmator may be employed, and the vapours may travel through them in obstructed paths, while fresh charging stock may be introduced with the vapours at such places as may be desired, the non-vapourised portion being returned to the cracking coil. The incondensable gas may be returned to the cracking zone to assist in the conversion. H. M.

321. Apparatus for Refining Oils. W. T. Hancock and M. Boyle. U.S.P. 1,576,742 of March 16, (Appl., of Oct. 8, 1923).

A still for converting heavy hydrocarbon oils into lighter oils has perforate pipes running longitudinally, their ends being supported by crown sheets spaced from the ends of the still to provide steam spaces. There are steam inlets at the ends of the still, a separator chamber connected to its upper portion, and a condenser connected with the top of this chamber. H. M.

322. Apparatus for Treating Oil. F. C. Vande Water and F. R. Sunderman, Assrs. to Petroleum Laboratories Inc. U.S.P. 1,575,663 of March 9 (Appl., of Jan. 16, 1923.)

A cracking still is provided with a dome, and a supplemental chamber within the dome is provided with a series of diametrically opposed valved openings, one set of which is connected with a gas supply and another set with the still body. H. M.

323. Distilling Hydrocarbons. F. E. Wellman, Assr. to Kansas City Gasoline Co. U.S.P. 1,576,564 of March 16 (Appl., June 3, 1922).

A cracking still is connected with a fractionator, and this to a supplemental still connected with a second fractionator. Both fractionators are connected to a condenser. A return pipe leads from the supplemental still to the cracking still. A feed pipe serves to supply fresh oil through the first fractionator and supplemental still. H. M.

324. Conversion of Hydrocarbons. W. M. McComb. U.S.P. 1,579,554 of April 6, 1926 (Appl., March 2, 1921).

Conversion of heavy oils into lighter oils is effected by means of a vertical spiral coil, the lower turns of which have an increased inclination to accelerate flow of oil. The coils are grouped for electrical heating. S. B.

325. Conversion of Hydrocarbons. G. Egloff. U.S.P. 1,579,601 of April 6, 1926 (Appl., April 26, 1917).

An externally heated still is provided with means for producing an electric arc simultaneously within the charge of oil. The oil is thus heated to a cracking temperature and the vapours passed through an atmospheric condenser, the reflux returning to the still and the uncondensed gases to the usual condenser. S. B.

326. Treating (Cracking) Petroleum Oils. R. B. Day. U.S.P. 1,570,131 of 1926 (Appl., Aug. 5, 1921).

An apparatus for cracking oils consists of a large reservoir, which also acts as a preheater and expansion chamber, and which is connected in series to a number of tubes superimposed in a horizontal position in a furnace. Each tube is fitted with a shaft and paddles, the rotation of which propels the oil through the plant and prevents deposition of carbon. The oil moves downward from the reservoir to the highest and least heated tube and passes successively through the other and progressively hotter tubes. The residue and carbon are removed, the vapours returning to the reservoir and thence through a dephlegmator and condensers to storage. H. G. S.

327. Heat Treatment of Hydrocarbons. H. R. Berry. U.S.P. 1,569,532 of 1926 (Appl., Dec. 6, 1924).

Hydrocarbon oils are cracked in presence of superheated steam which reacts with the liberated carbon to form oxides of carbon and hydrogen. The latter effects partial hydrogenation. The steam is introduced in such a way that it forms a " blanket " between the heated walls of the plant and the oil. H. G. S.

328. Process of Treating (Cracking) Oil. G. Egloff and H. P. Benner. U.S.P. 1,569,855 of 1926 (Appl., Aug. 20, 1920).

The simultaneous cracking of distillates or residues and refining of the pressure distillate produced is effected by distilling oil under pressure in a still and causing the vapours to traverse a bed of filtering material, *e.g.*, Fullers' earth, bone black, animal charcoal, etc. which is placed in the vapour space of the still above the oil level.

A dephlegmator condenses the heavier vapours, the condensate being then returned to the still at a point below the filter bed, while the uncondensed vapours are passed through condensers and the light distillate collected under pressure. H. G. S.

329. Process for Refining Oils, Hydrocarbon Oils or Cracked Hydrocarbon Oils. J. C. Morrell. *a*. U.S.P. 1,569,870 (Appl., Aug.28, 1922); *b*. U.S.P. 1,569,871 (Appl., Aug. 31, 1922); *c*. U.S.P. 1,569,872 (Appl., Aug. 31, 1922).

(*a*) Hydrocarbon oils, particularly cracked oils having a high sulphur content are first washed in the usual way with acid and alkali. They are then treated with aqueous sodium plumbite, the latter removed and the resulting oil agitated with a small amount of calcium, magnesium, aluminium or etc. sulphide suspended in water. The precipitate of lead sulphide which is produced is allowed to settle, withdrawn and the oil distilled.

(*b*) The lead sulphide precipitated as above is caused to settle rapidly by treating the oil with an electrolyte, *e.g.* dilute sulphuric or hydrochloric acid.

(*c*) The sulphides of hydrogen, sodium, potassium or ammonium, etc. may be used instead of the sulphides mentioned in (*a*). H. G. S.

Geological and Fields.

330. Discussion of the Question: "Where does Petroleum Come From?" By O. Stromberg. *Oil Age*, Jan., 1926.

The author outlines the probable formation of crude oil from oil-shales, and then passes on to examine the possibilities of natural distillation within the

earth's crust. The variation of earth temperature with depth is next dealt with, and a table is given which shows the depths required to produce temperatures sufficient for the destructive distillation of oil shale. The products of distillation will be held under the pressure of the strata above until such time as earth movements, particularly faults, enable the oil to migrate to other regions of the earth's crust. The importance of faults as a means of migration of oil is expanded upon, and examples such as the Grozny Field, the Panuco Field, and the McKittrick Field are given, where it can be shown that faults were the means of upward migration of oil.

It is pointed out that variation of gravity of oil in different fields can be explained by the fact that different temperatures of distillation of oil shale were operative in separate regions, and that a low temperature was likely to produce an oil of low specific gravity. W. H. T.

331. A Modern Method of Shooting Oil Wells. *Petroleum Times.* March 20, 1926.

The difficulties encountered in the detonation of a charge used for "shooting" a well are explained, and the various drawbacks of different methods of firing are touched upon. An electric time bomb is described, which appears to work quite satisfactorily in 97 cases out of 100.

The bomb consists of four essential parts :—(1) a cast-iron shell in which the mechanism is enclosed ; (2) a time mechanism ; (3) an electric dry battery ; and (4) the explosive. The cast-iron shell is water-tight, and is protected against the magnetic forces encountered in the well. The time mechanism is a clock-watch, through the dial of which a small hole is drilled immediately below the 12 o'clock figure. A platinum firing pin is inserted in the hole, and is connected to one pole of the battery. The hour hand of the clock makes contact with the pin, thus closing the electric circuit and fires the bomb. The battery is sufficiently powerful to set off ten No. 8 electric blasting caps. The caps are embedded in 1½ lb. of nitro-glycerine, which fills the lower part of the container. The bomb weighs 24 lb. when charged. The watch and battery are both tested before being used. Before setting the bomb, the main charge of nitro-glycerine is placed in position in the well, and the bomb is then lowered on to the main charge with the clock set at the required time. When this hour is reached, the hour hand of the clock makes contact with the firing-pin, closes the circuit, exploding the caps and nitro-glycerine, which, in its turn, sets off the main charge of explosive. W. H. T.

332. Oil in Canada. *Oil News.* April 17, 1926.

The article consists of a résumé of a report on the "Oil Prospects in the Vicinity of Battle River at the Alberta-Saskatchewan Boundary" (G. S. Hume). The stratography of the area is given as follows :—Bearpaw formation, Marine ; pale and variegated beds, non-marine ; Birch Lake formation, mostly non-marine ; Grizzly Bear formation, marine ; Ribstone Creek formation, non-marine in Alberta, partly marine in Saskatchewan ; Lea Park formation, marine ; Benton formation, marine (not exposed) ; Lower Cretaceous (?), not exposed ; Palæozoic limestones, not exposed. Over the whole of the area the regional dip is gentle, and local structures which might possibly contain oil are difficult to determine, except where a definite horizon can be followed. Detailed levelling has been carried out on the Ribstone-Blackfoot anticline, which has been shown to be a fold with a north-east south-west strike, with its crest in the vicinity of the exposures of the Ribstone Creek formation. The dip on the north-western flank of this anticline is about 23 ft. per mile, while that on the south-eastern flank is 10 ft. per mile.

The fold has not yet been tested for oil by drilling, but from a consideration of the regional distribution of oil and gas it would appear that there is some chance of striking oil on the anticline, and that the drilling depth would be between 1,500 ft. and 1,800 ft. A map and section illustrate the article.

W. H. T.

333. Salt Domes Associated with Oil Accumulation. *Cull & Co.'s Financial Review.* April, 1926.

The article commences by a short description of the discovery and subsequent exploitation of the Spindletop Field, Texas. This was the first "salt dome" oilfield and perhaps the most spectacular of the Gulf Coast fields. The dome is composed of a steep-sided, relatively flat-topped circular salt core, diameter about 1 mile, and has a cap of limestone, anhydrite, and gypsum surmounting the salt. Most of the oil was produced from the porous cavernous limestone at the top of the cap. There is a very marked bending of the strata as they approach the edge of the dome, so that they may be practically vertical as the salt plug thrusts towards the surface. An uplift of several thousand feet within a distance of one mile is not uncommon. It seems practically certain that the salt domes are the result of plastic yielding to deformation of pre-existent sedimentary salt formations. Salt domes are associated with saline waters, which are generally found on the flanks of the dome. The most important parts of salt-dome formations in relation to oil-finding are the cap and the flanks of the salt plug. Four probable hypotheses for the origin of the cap are given, as follows:—(1) that it is sedimentary limestone, largely altered by sulphate waters, and which has been picked up ahead of the plug. (2) That it is sedimentary anhydrite which has been pushed up ahead of the rising salt dome. (3) That it is a secondary deposit resulting from the precipitation of calcium sulphate. (4) That it is residual material which has been left behind in the solution of the salt. The sequence of geologic events leading to the formation of the dome seems to have been:—(1) The formation of the salt masses. (2) The formation of the cap rock. (3) The accumulation of petroleum, natural gas and sulphur in the cap rock. From a consideration of the points enumerated above, the tenable theories seem to be limited to:—(1) Residue left by the solution of the upper part of the salt plug. (2) Casual encounter of gypsum or limestone in the sedimentary rocks by the intruding salt. (3) Deposition from solution. After the dome has been formed it naturally follows that a suitable reservoir for collecting oil is made, providing that the stratum immediately overlying the cap rock is impervious to oil. The deformation of the late Pleistocene plain indicates upthrust, due to the movement of the salt core, or to hydration of the anhydrite in the gypsum cap. The intrusion of the salt into the Miocene indicates that the former is older than the latter. The American salt domes consist of subcircular masses of salt, capped in most cases by limestone and gypsum-anhydrite, intruded into and surrounded by Pleistocene-Eocene, or Eocene-Cretaceous sediments. The Roumanian salt domes consist of two groups:—(*a*) the Carpathian—narrow, elongated, vertical intrusions into a thick series of Pliocene and Miocene sediments; and (*b*) the Transylvanian. The distribution of the Roumanian oilfields is governed by lines of folding related to the major Carpathian overthrust faulting. Along these lines of folding the production tends to focus around salt masses. The major part of the oil comes from the Pliocene of the southern curve in Moldavia, the district of typical "salt dome" oilfields. Because of the fracturing, traces of oil have been found in practically every horizon. Short descriptions of four well-known salt dome fields in the Gulf Coast area are given, together with notes

regarding the types of oil, their gravities, and quantity. It is pointed out that a knowledge of the height and circumference of the dome, the lineal distance of the cap, and the depth of the flanks would not only be an efficient guide to successful drilling but would also avoid unsuitable well sites being chosen. W. H. T.

334. Rodless Hydraulic Pump Proves Success after Extensive Field Tests. C. A. Zimmerman. *Oil Age*, 1926, xxiii. (5) 23.

The Alta Vista Hydraulic Pump claims to eliminate all rod troubles, breakages, etc., and has only three working parts, a plunger, a pilot stem and a piston valve. The surface gear consists of a gasoline engine or other power for operating a hydraulic pump which builds up pressure in an accumulator tank. The fluid, under pressure, is led to a macaroni string inside the regular tubing, which is attached to the valve head and pump. The pressure fluid passes through a valve, down a crescent port to the underside of the plunger. The plunger is thus raised, expelling the oil into the production tubing. When the plunger reaches the limit of its upward stroke it engages a lug on the pilot stem which closes the inlet port of the valve and directs the pressure liquid to accumulate storage. At the end of the downward stroke a lug at the lower end of the pilot stem is engaged and the valve inlet port opened for the start of the next upward stroke. G. S.

335. Petroleum and Natural Gas Development in Alberta. Charles C. Ross. *Trans. Can. Inst. Min. Met.*, 1926, 29.

Turner Valley.—The rocks exposed in the Turner Valley, some thirty miles south-west of Calgary, are Benton shales, Upper Cretaceous, underlain by a calcareous green shale followed by the Dakota formation. This latter is underlain by the Kootenay formation, Lower Cretaceous.

In September, 1922, the Royalite No. 4 well was "spudded in," and in the fall of 1923, at a depth of 2890 feet, a flow of 7 million cubic feet of wet gas per day was obtained. On October 24th, 1924, at a depth of 3740 feet, a flow of 21,500,000 cubic feet of wet gas per day was obtained. The pressure then being considered normal, the well was closed. In the first minute 200 lbs. was registered, 400 lbs. in the second, and 600 lbs. in the third, and when 1150 lbs. was reached the crew retired to a safe distance. In 20 minutes 3053 feet of 8¼-inch and 3450 feet of 6¼-inch casing, weighing 94 tons, was lifted to the crown block. The gas then escaped from between the various strings of pipe, and the casing then subsided. The 6¼-inch casing is believed to have been burst, and the pressure was estimated to be about 2500 lbs. per sq. inch. The 3740-foot column of water standing in the casing was blown clear of the well. On November 9th, 1924, the well caught fire and was not extinguished until November 30th, seven boilers being used to supply steam for this purpose. The well was then connected and drips installed to recover the naphtha, of which about 300 barrels per day was collected. The drips were subsequently replaced by Smith separators, and the production increased to about 450 barrels, the average for 1925 being 456 barrels per diam.

A 4-inch welded pipe-line has been laid to the Imperial Oil Company's refinery at Calgary, some 35 miles distant, and a 10-inch gas line connects with the same town, where the gas is sold, after removal of the hydrogen sulphide, at 10 cents. per 1000 cubic feet.

In addition to No. 4, the Royalite Nos. 1 and 2, drilled about ten years ago, yield gasoline from their gas, the total for 1925 being about 9000 barrels. In November, 1924, the McLeod Oil Company's No. 1 was drilled in at 2397 feet, the production for 1925 being about 4000 barrels, and during 1925 the Canada

Southern No. 1 yielded oil from a depth of 3511 feet, the total for the year being 1000 barrels.

Foothill Areas.—In the Rice Creek and Highwood area five wells, ranging in depth from 232 to 4020 feet, have been drilled, but no definite results have been obtained.

In the Bragg Creek, Moose Mountain, Jumping Pound and Bow River areas ten wells were drilled to depths ranging from 950 to 2400 feet during the 1914 boom. Interest in these areas is being revived.

At Coalspur two wells have been drilled and one, at a depth of 3988 feet, has obtained five gas shows and two oil shows.

At Pouce Coupe, of three wells one reached a depth of 3057 feet, obtaining 10 million cubic feet of dry gas per day from 1675 feet. Oil prospects were abandoned in 1923.

Peace River.—Fourteen wells have been drilled, but all those reaching depth have met water under high pressure.

Fort Norman.—Of nine wells drilled, seven were abandoned, the other two obtaining oil at a depth of about 1000 feet, the production being 100 and 110 barrels daily.

Athabasca.—This area is noted for its tar-sands and wells drilled to obtain information relating thereto have been abandoned. At Pelican Rapids deeper wells have proved a large gas field, but at present the market is too far distant, this area being kept as a reserve.

Viking.—Several wells drilled in 1924 ranged in production from 2 to 7 million cubic feet of gas per day. In 1925 two new wells were brought in with yields of 7 and 9 million cubic feet daily, the rock pressure being 710 lbs.

Wainwright.—Of 18 wells commenced drilling, 9 have produced oil or gas, or both. Production is obtained from lenticular sands in the Kootenay containing gas, oil and water, separated only by thin partings of shale. It is therefore difficult to produce oil without water.

Medicine Hat.—The first natural gas well was drilled in 1885 and in 1890 a flow of natural gas was met with in a well within the city limits. In 1904 the Medicine Hat gas sand was first penetrated, the closed pressure being 645 lbs. and the open flow 2,225,000 cubic feet daily. Since then 28 wells have been drilled at Medicine Hat and 9 at Ratcliff. At Many Islands four wells have been drilled, obtaining gas from a depth of about 1500 feet. In 1925 a deep test well for oil was drilled and at 1081 feet a daily yield of 2,600,000 cubic feet of gas was obtained.

Bow Island and Burdette.—Twenty-seven wells were drilled, initial pressures being from 675 to 1010 lbs. and open flow from 1,300,000 to 29,000,000 cubic feet per diem. Producing wells are now few in number, and water has encroached so much that production from the Bow Island sand is practically finished. Lower horizons in the south appear to have possibilities.

Foremost.—The initial closed pressure of nine wells ranged from 585 to 640 lbs., with an open flow of as much as 17,000,000 cubic feet daily. Two wells (Nos. 5 and 6 of the Gas Co.), completed in 1925, gave 11,000,000 and 1,330,000 cubic per day, and in No. 5 at 2005 feet in the Benton shales a show of oil was encountered.

Boundary Area.—Eight wells out of fourteen gave shows of oil or gas, or both, and the Rogers-Imperial, the largest gas well in Canada, yielded 50 million cubic feet of gas per day, the pressure being 1180 lbs.

This area is in the vicinity of the Kevin-Sunburst field, Montana, the subsurface structures showing marked similarity. The Milk River sandstone, up to 300 feet in thickness, is underlain by about 1770 feet of black Colorado shales, followed by about 450 feet of the Kootenay. At the base of the Kootenay is the Sunburst Sand, varying from a thin layer to 20 feet in thick-

ness, being entirely absent in some places. The Ellis formation, Jurassic age, underlies the Kootenay and varies from 200 to 250 feet in thickness. The producing sand (Ellis) is irregular and occurs at the contact of the Ellis and the Madison limestone.

General.—Up to the end of 1925 about 326 wells had been commenced in Alberta. Of these 127 obtained gas and 10 oil in commercial quantities, 25 to 65 shows of oil or gas or both, and about 120 were never completed. During 1925, 33 wells were in operation, 6 being completed, 3 abandoned, 6 obtaining gas and 4 oil in commercial quantities, and 14 shows of oil or gas or both. In 1926, ten new wells in the Turner Valley, five in the Moose Mountain and Bow River areas, four in Wainwright and three in Southern Alberta are assured. G. S.

336. Geophysical Exploration of Oil Lands with the Torsion Balance. J. B. Reid. *Oil Age*, Jan., 1926.

The author gives a short account of the growth of Torsion Balance technique and its application. The Torsion Balance is an instrument suitable for measuring slight differences in gravity caused by masses in the earth's crust being lighter or heavier than the normal density. Fundamentally, the instrument consists of a beam carrying a suspended weight, counterbalanced by another weight, and suspended by a thread from a fixed point.

The movement of the weight due to the peculiar construction of the instrument does not oscillate the pendulum about the end of the beam, but causes the beam to rotate through the azimuth until it is stopped by the resulting tortional strain established in the thread. The thread is calibrated to an exact degree, and the amount of the movement being directly proportional to the dynal force caused by the attraction of the mass upon it, enables the mass attraction of the unknown to be calculated exactly.

In the field instrument, the suspended weights are hung in vertical tubes on either side of the circular column. The torsional thread is suspended within insulated tubes in the square section above the centre, the balance arms lying parallel in the horizontal casing. Triple casings are provided in order to protect the instrument from temperature changes and radiation effects. The machine is set up with the stops at zero and oriented to the magnetic North so that gravimetric readings may be properly charted on the maps.

The rotating portion is adjusted so that the machine will rotate mechanically from one stop to the next after a pre-determined time, which is regulated by an electric time clock. At the top of the instrument, a small electric light is flashed on at the time set for registration and, by means of an optical lever, is returned from the fixed mirror to a photographic plate, and establishes permanently the gradient of gravity at this location.

The machine as a whole is easily dissembled for transportation, and its design adapts it for use in all terrain except that too soft to bear the weight of the instrument for the period of time required for the test.

The Torsion Balance is accurate to $1/10^9$ c.g.s. Mass or gravity attraction is dependent upon the mass and the distance between their centres of gravity as laid down in Newton's formula—$F = f\frac{M_1 N_2}{R_2}$ where M_1 and N_2 are the masses attracting each other, and R is the distance between their centres of gravity. f is the factor indicating the value of the attraction of two masses of one gram each through a distance of 1 cm.

The article gives two examples of the interpretation of Torsion Balance results, and indicates the growing importance and value of this method of geological mapping when applied to the search for oil. W. H. T.

337. The Value of the Torsion Balance in Petroleum Geology. James G. Templeton. *Oil News*, 1926, **19**, 253-255, 281-285, 308, 309.

The Torsion Balance, designed to measure minute changes in gravitational fuses, was the invention of the late Baron R. Eötvös. Dr. Hugo de Böckh is credited with the conception of its aid to geologists, and the Anglo-Persian Oil Co. was the first to carry out extensive tests. Considerable progress has been made in a few years and it is suggested that the Torsion Balance might be profitably used in locating petroleum in Iraq, the Tamasopa Limestone of Mexico, and in Texas.

In Hungary a horse-drawn van is used for the instrument, in Texas a motor truck, and a smaller type, the Süss, can be carried by one man on his back. It is possible with two instruments to complete six stations per day.

Geological knowledge and experience are essential for successful results, and the plan of survey varies according to local conditions. G. S.

338. The "Cevrka" Pump for Deep Oil Wells. P. Stein. *Petr. World*, 1926, **23**, 50, 52.

This pump has been designed by G. H. Clerkx van Keulen in order to overcome sand troubles. In order to attain its object the piston is solid, without any valve. The upward stroke sucks the oil into the body of the pump, and the downward forces it through a bottom outlet, fitted with a ball valve, into a separate column of tubing. The pressure for the downward stroke is provided by a column of non-detrimental fluid, such as water, the pressure being increased if necessary by the introduction of compressed air. The rods operating the piston are fitted with jars to minimise strain. With a piston diameter of 10 inches, working tubing 2 inches, and ascending tubing 1¼ inch inside diameter, the maximum space required would be under 6½ inches in diameter. G. S.

339. Quick-Setting Cements in Oil Wells. C. C. Thomas. *Oil News*, 1926, **19**, 209-212.

The chemistry of cement setting and the properties claimed for Alta Lumnite cement are dealt with first. Cement manufacturers usually make a high grade cement for oil-well purposes, leaving the user to add what reagent he considers necessary. Such reagents include chlorides of calcium, barium, strontium or aluminium, and carbonate and bicarbonate of sodium. The procedure adopted by several American companies is given, and a summary of 323 cementing operations in Kern country, California, in 1924 shows that of 91 wells cemented with ordinary cement, 12 were failures or 13·2 per cent.; of 232 in which a quick-setting reagent was used only 10, or 4·3 per cent., were failures. G. S.

340. The Hild Electric Drive. Thomas Fleming, jun. *Oil News*, 1926, **19**, 692, 237-238, 268-269.

The first drilling rig fitted with the Hild Electric Drive was put into operation in December 1923. Since that time only minor changes have been made in the design and six wells have been drilled with the original outfit. A full description of the operation of the gear is given. As an example of the economy effected by the use of electric power the average cost of drilling

six wells to a depth of 3451 feet with electric energy at 2 c. per KWH was $706·11 per well, the equivalent cost of steam-power based on 25 barrels of oil per day at $1·50 per barrel being $1,919·50 per well. G. S.

341. Heat Treatment-Cooling and Dressing of Fishtail Bits. Charles H. Shapiro. *Oil Age*, 1925, **22**, 37-39.

In judging the temperature of steel by colour the effect of light plays an important part. The length of heating prior to dressing rests on the judgment of the bit-dresser, which is very changeable, and the type and intensity of the flame is also important. When heated correctly the bit should be immediately dressed to the proper shape and gauge and should never be hammered when black and cold. When dressed, the bit should be allowed to cool slowly and then re-heated to slightly above critical temperature. When quenched it will be of a very fine crystalline structure. When heating for hardening, a sharp oxidising flame should not be used, but the heat distributed evenly across the blades. When the necessary temperature is reached the bit is removed from the furnace and quickly quenched. Low-carbon bits are quenched in water and high-carbon in oil. Water-quenched bits may remain in the bath until cold. Oil-quenched bits remain in the oil bath until all colour is gone and are then removed to the water bath. G. S.

342. Gas Lift for Well-Pumping in California. R. P. McLaughlin. *Petr. Times*, 1926, **15**, 417—418.

A paper read before the A.P.I. conference at Los Angeles, in which the gas-lift, a modified form of air-lift, as applied to oil wells is dealt with. The use of gas in place of air make the saving and recovery of natural gasoline possible and has the advantage of not oxidising casing and tubing. Applied to oil wells an adaption of the Saunders air-lift is used, the casing being capped and gas forced in, the oil flowing out through tubing. The tubing has several openings far below the normal fluid level, and as the gas pressure forces the fluid level down the gas enters the tubing. Instead of perforating the tubing a special foot piece can be used. G. S.

343. Mining Reports. Petroleum. Prospects of Development on the old Areas. *The Mining Journal*. No. 4, p. 313.

Wells 640—750 m. deep, on the Nadkirmakinsky and the Kirmakinsky layers in Balachani strike rich strata, manifesting themselves in fountains. Some of them are very productive and permanent, No. 308 on the 11th group, Balachani, having produced for 3 years. For the first month this well yielded 25,000 tons. Since then it has given about 85 tons daily. More than 10 such wells have been drilled since nationalisation. According to the geologists more than 40 such wells can be drilled in Balachani, more than 50 in Saboontchi, and in Romani several scores with a depth of more than 100 m. In Binagadi, Engineer Kraskov has erected a windmotor to supply energy to work deepwell pumps in groups. The first test gave satisfactory results.

Cracking process erection. Azneft has ordered from America the equipment for two works for cracking benzine. The capacity of these two works will be 2000 barrels daily. Besides this they are also ordering one from Vickers, of 1800 barrels capacity to crack mazout.

Prospect drilling. Grosneft has commenced drilling on new deposits, discovered by the geologists, at Naibardi village, near to the Gudermess oil pumping station. The oil strata of the new deposits are 860 m. deep.

New tanker. The Neftsyndicate has ordered from the Nicolaieff works one oil tanker of 10,000 tons capacity, for foreign deliveries. The tanker is to be completed in 29 months. T. W.

344. The Result of Petroleum-Borings in Egypt [and Arabia]. J. Martynik. *Petroleum-Zeitschrift*, 1926, **23**, 604—606.—

Fruitless borings have been made at the following places: Kabrit, near Shaluf et Teveba, on the left bank of the Suez canal, one boring, 2000 feet; Bir Abu Tif in the Sinai Peninsula, one boring, 1800 feet; Gebel Tanka, Sinai, two, average 1800 feet, oil traces at 300 feet; Nezzazat, Sinai, one, 200 feet, oil traces at 80 feet; Ras Gharib, Egyptian coast of Suez Gulf, two, 2000 and 3700 feet, oil traces at 300 feet; Ras Dhib, Egypt, four, 400, 1200, 1800, 2000 feet, oil traces in two of these at 1000 feet; Ras Ranim, Egypt, one, 2500 feet; Ras Mohammed, Sinai, one, 1000 feet; the island Ashrafi, one, 1000 feet, still boring; the island Um el Hamet, one boring; Ras Bahar, one, closed down at 1000 feet; Ras et Lush, Egypt, one, 1000 feet, oil traces at 300 feet; Abu Shaar, Egypt, two, 3500 and 500 feet; Dishet Abu Mingar, Egypt, one, 2000 feet; the island Gefatin, one, 1500 feet. Seventeen borings, three of which have been abandoned, at Abu Durba in the Sinai peninsular produce about 15 tons per day of a blackish-green oil having $d^{15°}$C. 0·950, flash point above 150° F., viscosity (Redwood No. 1), at 100° F., 3000 secs., sulphur 2%, asphalt 9%, no distillate to 150° F., 15% distillate to 290° F. ($d^{15°}$ C. 0·860). Two borings in commission at Gemsah, Egypt, produce 150 tons per month each of a dark green oil, $d^{15°}$C. 0·830, flash point above 100° F., viscosity (Redwood) 2000 secs. at 100° F., 0·7% sulphur, 0·8% asphalt, specific gravity of distillates (?) at 15° C. 0·755. There are about seventy borings of average depth 2000 feet at Hurghada, Egypt. The monthly production for the last five years has been about 12,500 tons. The oil is dark brown, and has $d^{15°}$C. 0·925, flash point below 60° F., viscosity (Redwood) 500 secs. at 100° F., sulphur 2·25%, asphalt 10%. Specific gravity of distillates (?) at 15° C. 0·810. The oil contains about 35% brine which is reduced, for exportation, to 3—5% by an electrical dehydration plant. W. S. N.

345. Oil-Bearing Chalks at Heide in Holstein. G. Keppeler and J. Schmidt. *Zeit. angew. Chem.*, 1926, **39**, 220.

A purely local chalk at Heide, Holstein, is impregnated with oil, the content of which varies, reaching 20%. Solution of the chalk in hydrochloric acid is not a practicable means of obtaining the oil, since complete solution is not possible, owing to the presence of clay, etc. Extraction by means of cold benzene gave a black oil, *d* 0·970. A green oil having a reddish brown fluorescence is obtained, in a yield of 73·5% of the organic material present, by the action of heat. In this operation the yield is increased to 89% by the use of steam, carbon dioxide, or hydrogen. A residue of asphaltic material remains, and loss occurs by the escape of gas, which contains hydrogen sulphide, carbon dioxide, heavy hydrocarbons, methane, and hydrogen. A comparison of the oil obtained with an oil from a local seepage shows that the shaling process gives a lighter oil containing less asphalt and less unsaturated material. The oil from the retorting process contains 2—6% benzine, 45—50% kerosene and gas oil, 45—50% lubricating oil. The use of steam, carbon dioxide or hydrogen partly prevents decomposition during shaling, the production of unsaturated aromatic compounds being, in particular, repressed. With hydrogen, partial hydrogenation also apparently occurs. W. S. N.

COAL AND SHALE.

346. THE SCOTTISH SHALE-OIL INDUSTRY. *Petr. Times*, 1926, **15**, 599–602, 639–643.

The report of the Court Inquiry set up to deal with the wages question in the Scottish shale-oil industry is summarised. Comparing the year 1913-1914 with the half year ended September 30th, 1925, the value of products per ton of shale was 12s. 6d. in the former and 12s. 5d. in the latter, cost of production 9s. 11d. and 14s. 2d., the profit in 1913-1914 being 2s. 7d. and the loss in 1925 1s. 9d. For the six months ended September 30th, 1925, the net loss, before allowing depreciation, was £77,822; if depreciation at standard rates is charged the loss was £177,519; and the loss, allowing income and expenses apart from oil-shale operations, but excluding depreciation, was £57,776. Had there been no strike the loss from the six months ending March, 1926, would have been £80,036 (estimated). G. S.

347. KANSAS SHALE GAS WELLS ARE SMALL, BUT PERSISTENT AND PROFITABLE. A. F. Hinton. *Natl. Petr. News.*, 1925, **17**, 107, 108, 110, 112.

Shale gas, which is practically odourless and almost pure methane, is found in a black shale about 20 feet below the top of the Oswego lime. The shale gas district extends from Coffeyville to Buffalo; an active shale gas territory also extends from Independence for 35 miles north, with a width of 6-10 miles. The number of wells at present yielding the gas is estimated at 500, with a total daily output of about 15 million cubic feet of gas. In drilling the wells, 200-300 feet of 6½ inch casing are used to shut-off upper waters, and is withdrawn on completion, leaving only a small amount of surface pipe. Two-inch tubing is run to the bottom and a tubing packer set at the top of the Oswego. A cage is set at the top of the shale, and a 2-inch Henceroth packer housing is inserted a foot above. The 2-inch tubing leads to a stuffing box above the casing-head, from which a 1-inch pipe rises and turns into a separator. Dry gas is blown from the top of the separator, water leaving by a bottom outlet through a 1-inch pipe to a point about 200 feet down in the well. The average cost of a shale-gas well is $1·30 per foot complete, the separator costing an additional $18 to $23. G. S.

348. BERGIN BENZINE AND OIL. E. LASZLO. *Petroleum*, 1926, **22**, 421–425.

The products examined were obtained by Berginising in a 50-litre bomb, by the continuous process, a mixture of 100 kg. of Italian lignite, 67 kg. of topped coal tar and 4 kg. of a mixing medium, with the addition of 5 kg. of hydrogen. The finely-ground lignite was brought to a pasty consistency by mixing with the tar. The lignite contained 13·8% of water, 8·45% of ash and 0·8% of sulphur. Hydrogenation took place at 470° C. under a pressure of 140 to 150 atmospheres. The expansion gases were debenzinised with activated charcoal, yielding 8 kg. of benzine, 20 kg. of gas were formed and 139 kg. of runnings, with a loss of 9 kg. The benzine was water-white, with an odour of natural petroleum benzine, and a sp. gr. of 0·7303. 84·6% distilled over from 50° C. to 120° C., and the product was easily refined. The relation between boiling limits and sp. gr. correspond to that of American benzine. The lower fraction obtained by distillation of the runnings had a sp. gr. of 0·990 and contained 12·5% of constituents soluble in alkali (phenols), being similar to low temperature tar oil. The wax content was 1% to 1·5%, and the oil was suitable for use as Diesel fuel. The residue of distillation was a very viscous syrup, capable of use for rope grease. On redistilling, 47% of hard asphalt remained, indicating a total asphalt content of about 60%, but the ash content was small, and so the residue might be used for asphalting roofing felt and for briquetting. A third part of the runnings consisted

of water (29·5 kg.) containing 7·83 g. of ammonia per litre, of which 3·24 g. were free ammonia. This only corresponded to 19% of the nitrogen present in the raw material, and it appeared that the remainder had escaped as ammonia in the expansion gases. H. M.

349. Some Notes on Kimmeridge Shale Oil. J. S. Remington. *Ind. Chem.*, 1926, 150.

Kimmeridge shale with a moisture content of 10·84% gave on distillation in the laboratory an oil containing 6·8% of sulphur. Various attempts were made to obtain an oil with a low sulphur content by distilling mixtures of the finely ground shale with respectively 15% to 30% of lime, 20% of lime and 5% of caustic soda, 10% of soda ash, 10% of caustic soda and 5% of potassium permanganate. In another experiment the oil was treated with 5% of sodium peroxide, and finally the oil vapours were passed over anhydrous copper chloride and then through alkaline lead solution.

All these methods proved more or less useless. Thus a hundredweight of a finely powdered mixture of shale with 15% of lime gave 50·4 gallons of oil (per ton of shale) with a sulphur content of 4·87%.

The best results were obtained by distilling powdered shale with which had been intimately mixed 15% of caustic lime and 5% of a substance X. The yields of oil were of the order of 50 gallons per ton, the sulphur content being from 2·44 to 2·53%.

The product was fractionated as follows :—

°F.	%
0 — 180	12·7
180 — 280	26·8
280 — 300	8·2
300 — 350	32·4

The second fraction was found to contain only 0·26% of sulphur.

The shale ash was tested as a base for manures with encouraging results. H. G. S.

350. Esthonian Oil-Shale. P. N. Kogerman (*Brennstoff-Chemie*, 1926, 7, 173–176).

The shale of Esthonia, estimated by borings to be present to the extent of 5,000 million tons, occurs in the Lower Silurian in beds 2–2·4 m. thick extending over 2400 sq. km. The freshly won, greenish-yellow to reddish-brown shale is hard, but the weathered shale is elastic; the upper strata, also those lying beneath alluvial (or diluvial) sand, are strongly weathered. The unweathered, air dried shale gives on coking 42·7–60·1% volatile matter, 2·9–9·7% coke, 36·0–53·0% ash. The organic material contains 71·1–72·4% carbon, 8·0–9·0% hydrogen, 0·2–0·5% nitrogen, 1·5–2·0% sulphur (chiefly inorganic). The organic material has cal. value 8000–8800 cal./kg. The shale is used as a substitute for coal in firing locomotives or stationary boilers, in lime roasting, cement making, etc. The ash has practically the composition of Roman cement, and can be used as a binding material, also for the production of artificial building stone. The shale is also used for the production of lighting gas, the yield of which is 280 cub. m./ton; the gas has cal. value 4300–4500 cal./cub. m.—after purification (less than 1% carbon dioxide) 6000 cal./cub. m. As by-product in the production of gas, there is obtained 3–5% of tar rich in aromatic compounds. Retorting at 550°–600° C. gives 15–22% of shale oil, $d^{15°}$C. 0·946–1·170, containing 27–55% unsaturated

material, 36–50% phenols: the latter are used for treating railway sleepers, etc. Redistillation of the shale oil after removal of the phenols gives benzine, kerosene, Diesel oil, lubricating oil, and a tar suitable for use in the manufacture of roofing composition. The benzine has *d* 0·765, 14% distillate to 100° C., 25% to 110° C., 36% to 120° C., 50% to 130° C., 62% to 140° C., 72% to 150° C., 83% to 160° C., 89% to 170° C., 96% to 180° C. The kerosene has *d* 0·813–0·850, flash point 36° C., sulphur 0·68–0·77%. The Diesel oil has *d* 0·900; cal. value 10,200 cal.; viscosity 20° C. 1–2° E.; flash point 55°–60° C.; coking number 0·5%; sulphur 0·62%; traces of hard asphalt; distillate to 200° C. 5%; 40% to 250° C.; 80% to 300° C.; 96% to 330° C. Lubricating oil (for waggon axles) has *d* 1·005–1·006; viscosity 50° C. 9–10° E.; flash point 162°–166° C.; hard asphalt 3·2–5·6%. A somewhat more valuable lubricating oil has *d* 1·011; viscosity 50° C. 8·3° E.; flash point 152° C.; traces of hard asphalt. Work is in progress on the hydrogenation of this shale and of the shale oil. W. S. N.

351. The Constitution of Swedish Generator Shale Oil. G. Hellsing and J. S. W. Troedsson. *Arkiv Kemi, Mineral, Geol.*, 1925, **9**, No. 22, 1–12.

The authors have investigated the composition of the shale oil obtained by the dry distillation on a large scale of Swedish alum shale. The crude oil boiled from 150–300°. After a preliminary treatment with sulphuric acid followed by washing with caustic potash, it was fractionated several times, and a fraction b.p. 150–185°, amounting to 0·99% of the whole, collected. Oxidation by permanganate gave a loss of 17·5% which was assumed to be due to the presence of unsaturated hydrocarbons. The oxidised oil was again fractionated and the distillate boiling from 155–185° sulphonated. The loss on sulphonation amounted to 60·67%. The sulphonic acid was converted through its sodium salt into the sulphonamide which, after recrystallisation from ether, melted sharply at 175°. This substance was identified as *pseudocumenesulphanomide*. The unsulphonated hydrocarbons consisted mainly of decanaphthenes, b.p. 160–175° and hendecanaphthenes b.p. about 180°. The nitration products included nitro-bodies and some oxalic acid; bromination of these nitro-compounds gave a heavy oil, probably $C_{10}H_{18}NO_2Br$. The unsulphonated oil on bromination in a sealed tube gave a crystalline compound, probably 2:4:6 *tribrom*:1:5 *dimethyl*:5:*ethyl benzene*; the parent naphthene would thus be β-decanaphthene. From the losses on oxidation and sulphonation, it is concluded that the generator shale oil is lower in unsaturated and higher in aromatic hydrocarbons than shale oil obtained by direct dry distillation, the corresponding losses for which are 31·0 and 33·0% respectively. S. F. B.

352. The Low-temperature Carbonisation of Coal. A. C. Fieldner. *Fuel*, 1926, **5**, 203–214, 265–271.

The general aim of low-temperature carbonisation is to obtain a larger yield of liquid fuels than results in high-temperature processes. In Germany and France this aim is supplemented by the necessity of manufacturing a low-volatile semi-coke to mix with high-volatile gas coals to produce dense metallurgical coke: and in England by the desire to obtain a smokeless fuel for domestic grates. A fourth object is to combine low-temperature carbonisation with powdered fuel firing.

Externally Heated Retorts.

After discussing general methods of heating the coal, the author describes some processes typical of each method. Thus the coal in thin layers may be

heated without stirring in vertical retorts, as in the Parker, Wallace or Rolle systems: or in horizontal ovens or retorts as in the Piron-Caracristi process. The Parker process utilises small diameter, intermittently charged, cast iron retorts, 32 of which have a capacity of 50 tons per 24 hours. The semi-coke produced is hard and compact and makes an excellent domestic fuel but it labours under high operating costs. The Wallace (U.S.A.) and Rolle (German) retorts are fitted with an inner perforated pipe to enable the gases and vapours to be withdrawn without being cracked. The former has not yet been tried out on a large scale but the latter has operated for years in distilling brown coals for their wax and oil contents; its use is limited to the non-coking brown coals of Germany. The Piron-Caracristi method adopted by the Ford Motor Company carbonises powdered coal on a conveyor belt, which travels continuously on a bath of molten lead. The 400 tons per day oven was erected in 1924 contiguous to the power plant burning pulverised fuel, but details of design have not yet been worked out satisfactorily. Carbonisation in an externally heated, vertical retort, with stirring of the charge, is effected in the Greene-Laucks process, the coal being carried upwards on a worm conveyor, further heat being supplied through the hollow conveyor shaft. A throughput of 24 tons per retort per day is claimed and a good strong semi-coke results. The McIntire method, a modification of the "Smith" or "Carbocoal" process, consists in carbonising coal in a horizontal, externally heated, stationary retort fitted with internal stirrers. Coking coals have thus been successfully treated but the semi-coke produced is granular and unsuitable for burning in open grates. The main practice in Germany is to utilise horizontal or slightly inclined, rotating, externally-heated retorts on the lines of Fischer's laboratory apparatus. Full-size units with various modifications have been built by Thyssen, Fellner-Ziegler, Bamag Meguin and by the Mathias Stinnes Colliery at Essen. In the Thyssen process, the charge of coal is carried through by spiral ribs on the inner surface of the retort, which is 8½ feet in diameter, 75½ feet long and is claimed to have a capacity of 100 tons per day. Fusing coals are difficult to carbonise by this method whilst the tumbling of the charge creates dust which is difficult to separate. The Fellner-Ziegler retort, mounted at an inclination of 5% from the horizontal, is heated externally and in addition to being rotated, is provided with a reciprocating stirrer to remove plastic coal from the retort surface. An attempt to increase the throughput of a given size of rotary is made in the Kohlenscheidung Gesellschaft double rotary retort, which consists of two concentric and slightly inclined cylinders. The coal is made to travel upwards through the inner tube, in which it is slowly preheated and then downwards through the outer and more strongly heated tube. The initial preheating is claimed to change the nature of coking coals and render them more amenable to treatment, whilst the introduction of superheated steam into the outer cylinder and the withdrawal of vapours in counter-current to the coal prevents cracking and increases the yield of tar. The Fusion retort, operated on a small experimental scale in Cheshire, resembles the Thyssen retort except that the spiral ribs of the latter are replaced by a star-shaped steel tumbler. It is possible to use a coking coal but the product requires to be briquetted for domestic use or pulverised for powdered fuel firing. The Dobbelstein process uses a rotating retort which is continuous and in which the coal is not stirred during carbonisation. It is described at greater length in this issue.

Internally Heated Retorts.

Methods which heat the charge by means of hot products of combustion, producer gas, water-gas, coal gas or superheated steam are usually continuous. Though of cheaper construction, such retorts are not suitable for coking coals, whilst the light oils cannot be profitably scrubbed from the gas. The

Maclaurin retort is essentially a large by-product recovery gas producer in which combustion of a portion of the semi-coke forms producer gas, the sensible heat of which carbonises the descending charge. The plant can be operated for complete gasification or for production of smokeless semi-coke, the latter, however, not being a high-class domestic fuel. The Glasgow Corporation has installed a battery of five producers, each to carbonise 20 tons per day, and yields of 22,000 to 27,000 cubic feet of gas, 12 to 17 gallons (U.S.) of dry tar and 14 to 15 pounds of sulphate per short ton are anticipated.

The Hood-Odell Carbonising process is similar to that of Maclaurin but no by-products are recovered. The sole object is to convert lignite containing 35 to 40% of water into a usable solid fuel. The carbonisation of pulverised coal to recover by-products and obtain semi-coke in powdered form is attempted in the McEwen-Runge process. Two vertical retorts are used. In the first, the powdered coal is dried and partially decomposed by heating with hot combustion gases and air containing heat recovered from the carbonised residue: thence it passes into the second retort, where distillation is completed by preheated distillation gases or products of combustion introduced into or generated within the retort. The method of rapid heat transfer to the coal increases the throughput but mechanical difficulties, *e.g.* separating dust from vapours are great.

The Seidenschnur-Pape and the Lurgi processes are used in Germany for carbonising brown coal in two stages by means of hot products of combustion.

H. G. S.

353. Low-Temperature Process Produces Hard Coke. A. Thau. *Chem. and Met. Eng.*, 1926, **33**, 227.

The author describes the Dobbelstein oven for low-temperature carbonisation of coal (*cf.* E.P. 226,543, 1924).

The plant consists of a cylindrical drum which is made up of a number of double-walled, transverse cells and which rotates slowly around an inner heating tube. The latter is divided lengthwise by a vertical wall into two chambers, one of which is closed at one end and is fitted with a burner at the other, whilst the second chamber is connected to a stack at the end nearest to the burner. The rotating drum is carried upon rollers, which also serve to compress the coal, and is fitted under its lower semi-circumference with an outer shell which is perforated to allow the gases produced from the coal to escape into the gas main.

The cells are charged with crushed coal by means of pistons which compress the material to about half its original bulk. As the drum rotates, the heating gases which pass through one chamber of the inner vessel are deflected by means of baffles through the spaces between the cells, thence to the second chamber of the inner tube and finally to the stack. The gases and vapours from the coal escape through the perforations in the outer shell and are subsequently collected.

Finally, when distillation is completed, the semi-coke is discharged into bunkers by means of plow-shaped pieces attached to the under part of the hopper.

A trial oven operated over a long period is 5 ft. long and 5 ft. in diameter. It has ten charging spaces, each 4 in. wide, giving a capacity of 10 to 15 tons of coal per 24 hours. The heating gases enter the cells at 550° to 600° C. the flue temperature being 340° to 350° C. The coke produced resembles metallurgical coke in structure but lacks its silvery appearance and strength.

H. G. S.

354. A Study of a Tar from the Low-Temperature Carbonisation of Coal. E. Parrish and F. M. Rowe. *J. S. C. I.*, 1926, **45**, 100-106 T.

A low-temperature coal-tar prepared at H.M. Fuel Research Station was separated into chemical groups by the method adopted by Brittain, Rowe and Sinnatt (*Fuel*, 1925, **4**, 263, 299,337) and various chemical entities isolated and examined. Distillation was avoided as far as possible to prevent alteration of constituents. The tar, which was produced by carbonisation in vertical retorts of coal from the Pooley Hall seam had d_{15}^{15} 1·0292 when dry. Distillation of the wet tar gave the following fractions: (*a*) to 170° C, 2·29 per cent. water and 2·79 per cent. oil; (*b*) 170—230° 20·45 per cent.; (*c*) 230—270° 14·35 per cent.; (*d*) 270—310° 12·69 per cent.; (*e*) residue 46·30 per cent.; loss 1·13 per cent. all yields by weight. Dilution of the tar with ether, followed by filtration and extraction successively with sodium carbonate, sodium hydroxide and sulphuric acid gave (*a*) soilds precipitated by ether, 0·30 per cent.; (*b*) solids precipitated from phenols by ether 1·78 per cent.; (*c*) carboxylic acids 0·31 per cent.; (*d*) phenols, 33·84 per cent.; (*e*) bases, 2·66 per cent.; (*f*) neutral oil, 54·72 per cent.; (*g*) water, 2·29 per cent.

The solids (*a*) precipitated by ether are probably more of the nature of dust than a tar product. The carboxylic acids were obtained as a brown powder which was insoluble in ether, benzene and water but soluble in alcohol, acetone, aniline, phenols and alkalis. The phenols were soluble in all common organic solvents except petroleum ether, which was used to resolve them into two main fractions. Phenol itself was present to the extent of 0·7 per cent. of the tar, a higher content than has been observed by other investigators. Pyrocatechol was also detected.

The bases consisted of 85 per cent. of tertiary compounds, primary bases being absent.

The neutral oil fraction contained 12·84 per cent. of saturated hydrocarbons, including 3·75 per cent. of solid paraffins. Benzene was absent, but higher aromatic hydrocarbons, which form picrates, amounted to 17·6 per cent. of the neutral oil. Naphthalene was also present to the extent of 0·1 per cent. All the fractions isolated contained sulphur compounds.

H. G. S.

Abstracts.

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General.

355. Regulations Proposed following the Tetraethyl Lead Investigation. *Ind. Eng. Chem.*, 1926, **18** (4), 432–433.

The regulations are formulated in accordance with the recommendations of the U.S. Surgeon General's Committee. In the manufacture of tetraethyl lead and its blending to make ethyl fluid, for addition to gasoline, the workers shall be given sanitary instructions and be submitted to periodical medical examinations, generally bi-monthly, of which records must be kept. Efficient ventilation of the plant must be provided, containers must be labelled, and cleansing and filling take place in a closed system. A dye shall be added to the ethyl fluid. In ethylising the gasoline the maximum amount added shall be 1/1260 of the commercial, or 1/1300 of the pure compound. It shall generally be done in tank car lots at distributing centres, which shall be registered, in the open air, or with ventilation. Precautions must be taken against leaks and spilling. Kerosene and washing facilities must be provided. A representative group of at least forty men must be periodically medically examined, the results being reported and recorded. Suitable notices and leaflets to be kept at filling stations, containers to be labelled, and ventilation and cleanliness insisted on. H. M.

356. Economy of Oil as a Boiler Fuel. Allen F. Brewer. *Oil & Gas J.*, 1926, **25**, 2, 162, 164.

Where oil is used as fuel in stationary boilers the utmost care and economy must be exercised, particular attention being paid to correct preheating of the oil, cleanliness of boiler and furnace, reduction of air leaks, control of air for combustion, and prevention of oil leaks. Lack of attention to these details will result in reduced evaporative power and consequent increased fuel consumption. For example, if an oil with an evaporative power of 14 lbs. of water per lb. of oil is used to generate 2,800,000 lbs. steam per day, and the evaporative rate is reduced to 12 lbs., the quantity of oil required would be 233,333 lbs. as against 200,000 lbs. at the correct rate. Assuming the oil to cost $1·50 per barrel, the loss per day would be about $150.

Preheating requires careful consideration. As a general rule, steam is used as the heating medium and for high gravity oils exhaust steam is suitable, but for oils requiring a firing temperature of over 200° F. live steam is best.

Although accumulations of dirt and soot are less than with solid fuel, a soot blower should be installed and turned on at least once a day. The cleaning of the water side of the boiler depends on the nature of the feed water. Imperfect atomisation will cause coking below the burners and clogging of the air spaces, with consequent loss of evaporative power. Hard firing under overloads may cause damage to brickwork and settings. The furnace should therefore be examined at regular intervals.

Leaks in boiler settings may admit air in excess of that required for combustion, and steps must be taken to prevent such leaks. Oil leaks from burner tips, pipe joints, etc., not only mean waste of oil but also a distinct fire hazard, and particular care is required in this respect.

Specifications for fuel oil are also of importance and should be based more particularly on the conditions under which it is to be used, rather than on ideals of calorific value, fire point, sulphur content. G. S.

357. Surface Combustion and Its Influence on the Future Economics of Heat and Power. Major T. G. Tulloch. *J. Soc. Chem. Ind.*, 1926, **45**, 33, 280T–287T.

This is a paper read before the London Section of the Society of Chemical Industry on March 29th, 1926.

"True" surface combustion is that which arises when a mixture of a combustible gas is passed through a porous diaphragm of refractory material, supported in an air-tight vessel, and lit on the outer face, causing the whole to glow with intense heat. Many problems have arisen in the design of such diaphragms, but after many years' work F. J. Cox has evolved a combustion which has solved them. The economics of surface combustion are considerable. To raise the temperature of a culinary oven to 160° requires 15-20 minutes with electricity, 8–10 with Bunsen burners, and about 4 min. with combustors. Many users record savings in gas consumption of 20 per cent. to 60 per cent., and in addition health conditions are considerably improved. Combustors can be made to any shape, and are therefore applicable to any form of heat treatment.

Further economics can be effected by the use of producer gas in place of town's gas. In England, the only fuels, other than coal, are peat and oil-shale. If the peat could be economically dried, coal mining would be unnecessary for 200 years. Shale, containing as little as 5 per cent. oil, is capable of gasification. G. S.

358. Protecting "Doctor" from Carbon Dioxide Pollution. L. J. Catlin. *Ind. Eng. Chem.*, 1926, **18**, 319.

Distillates treated with sulphuric acid are generally given a water wash before treatment with doctor solution in order to remove traces of acid which otherwise prove deleterious to the doctor solution. The present author observed during tests recently carried out, using an extra tower containing "spent" doctor between the water wash, that when the spent doctor solution was allowed to remain until neutralised, the resulting product was almost pure sodium carbonate. The explanation appears to be that acid from the distillate attacks the bicarbonate present in the water, liberating carbon dioxide which is then carried over with the oil. Although not harmful to the oil it is detrimental to the doctor solution and is an obstacle in the way of its recovery. It is therefore suggested that instead of the water wash between the acid and doctor treatments, a treatment with a cheap reagent capable of neutralising the acid (*e.g.*, lime) might be substituted. S. F. B.

359. California Petroleum Insecticides. G. P. Gray and E. R. de Ong. *Ind. Eng. Chem.*, 1926, **18**, 175–180.

Petroleum oils and their derivatives are markedly toxic towards insects and are amongst the most important insecticides at present in use. Originally it was the more volatile distillates that were employed, particularly kerosene which has now been in use for spraying for a number of years, but recently there has been a tendency to replace the more valuable refined products by the crude oils themselves. Certain of these have proved to be

cheap and effective materials for spraying foliage and for controlling mosquitoes. Experience however has shown that not only are the crude petroleums more toxic to the insect but they are also more toxic to vegetation. Their use, or the use of their products on plants, however, may be attended by little or no deleterious effects, but cases are on record of vegetation being damaged by them. For this reason the authors have carried out laboratory and field tests on thirty-five petroleum distillates which they considered to be representative of the types of oils in use as insecticides. It was soon found that physical tests alone gave insufficient data regarding the toxic nature of the oils. Thus, the density of an oil directly from the still gives a rough estimate of its toxicity towards vegetation, the toxicity increasing uniformally with the gravity. If, however, the oil has been prepared by blending it is no longer possible to estimate its toxicity. Again, a heavy oil freed from unsaturated and aromatic hydrocarbons by sulphuric acid becomes quite harmless. On the other hand, the oil recovered from acid sludge and therefore rich in aromatic hydrocarbons, although possessing the gravity of a kerosene, was found to be one of the most toxic oils examined. Density is of service in determining the probable toxicity of the oil to plants if the oil is obtained directly from the still, providing, of course, that it is not prepared from a crude unusually rich in aromatics or in a still designed to give a partially cracked distillate. The fact that the oil recovered from acid sludge was so deleterious to vegetation led to the conclusion that the constituents which are capable of being removed by acid from a petroleum distillate are the most toxic to foliage. A test was therefore devised which consisted in finding the percentage of the oil soluble in 37N sulphuric acid and it was found from field and laboratory data that this method of examination was the most valuable one tried. By means of this test it was shown that the toxicity of the oils tested appeared to increase roughly in proportion to the amount of aromatic and unsaturated hydrocarbons present in the oil. It is suggested that the oil recovered from acid sludge might find use as a herbicide, being practically as effective as sodium arsenic in the control of weeds. S. F. B.

360. Naphthenic Acids. M. Naphthali. *Chem. Umschau Fette, Oele, Wachse, Harze*, 1926, **33**, 1–4.

The author has employed Dakin's method of oxidation by hydrogen peroxide in the presence of ammonium hydroxide, in an attempt to prepare, from naphthenic acids, ketones having one carbon atom less than the original acids. The starting material consisted of naphthenic acids, freed from unsaponifiable matter having an acid value of 267 and a density of 0·9716.

These were converted into their ammonium salts and the latter heated in ammonium hydroxide solution under reflux. Hydrogen peroxide (30 per cent.) was then added gradually. The acids obtained in this way were redissolved in ammonium hydroxide solution, the solution oxidified, shaken out with petroleum ether and filtered through an hydrous sodium sulphate. On evaporation of the solution, an oily product remained which should have contained the ketones, but no detectable amount of these substances was apparent. This oil had an acid value of 613, gave no indications of the presence of lactones, and after purification to free it from hydroxy acids possessed an acid value of 67·67.

The analysis of its copper salt gave copper 12 per cent, a clear indication that the acids were unpolymerised, although this was contradicted by the low acid value which points to polymerisation. The subject is being further investigated. During the research the following test for naphthenic acids was devised: Nitric acid, S.G. 1·35–1·40, (0·5–1 c.c.) is added to one or two drops

of the sample to be tested in a test tube, and the mixture warmed by shaking in warm water. When the violent action, which follows the first darkening by nitrous fumes, commences the whole is immediately cooled, when the oxidised acids will be seen floating on the surface. The mixture is diluted, a little copper solution (10 per cent.) added, followed by dilute potassium hydroxide solution until a permanent green precipitate is formed.

On shaking with a little benzine, a green solution indicates the presence of naphthenic acids in the original sample. S. F. B.

361. The Hydrogenation of Organic Substances at a High Temperature and under pressure. André King and Daniel Florentin. *Compt. Rend*, 1926, **182**, 389–391.

The article is an attempt to explain the mechanism of the Bergius process. For each molecule of a substance a temperature exists above which the molecule commences to break down (crack), and for most substances this temperature corresponds with that at which hydrogenation of the degradation products commences. It is therefore probable that in the Bergius process, which is carried out at elevated temperatures under pressure, the hydrogen present reacts with the nascent degradation products from the substance being treated, at the time when these are produced.

The method should prove of great use in the laboratory in studying the influence of heat upon organic substances, for if the conditions of operation are suitable, only saturated hydrocarbons and no tars are produced. The mechanism of the dissociation can then be traced through the hydrocarbons obtained. The method also allows distinction to be made between molecules of different stability and indicates which of any number of constitutions assigned to them is the most probable.

For example, oils which are hydrogenated with difficulty give almost exclusively cydic (benzenoid) products, proving that the molecules of the original oil have a cydic structure. Other applications of the method are described. S. F. B.

362. Cresylic Acid from Petroleum Distillates. L. J. Cattin. *Ind. Eng. Chem.*, 1926, **18**, 743–744.

The cresylic acids described were prepared from the initial soda wash produced during the refining of cracked distillates in a continuous treatment plant. The soda was neutralised by still gases containing hydrogen sulphide, but it was found necessary to use a considerable excess of the hydrogen sulphide in order to obtain a clean separation of the crude oily acids. An examination of these acids indicated that cresols were absent and that roughly 27 per cent. of high boiling tar acids were present. The crude acids possess a very strong odour, owing to the presence of mercaptans, etc. A method is also described for the recovery of sodium sulphide from the product of the neutralisation of the soda by the still gases. S. F. B.

363. Attempts to Transform Naphthenic Acids into Ketones. G. L. Stadnikov and A. A. Doudé. *Trans. Karpoo Inst. Chem.*, 1925, **4**, 188–190.

As the Senderens reactions cannot conveniently be applied to naphthenic acids, the authors have made use of the method of A. Grün (German Patent 295,657) which consists in heating organic acids boiling above 300°, to between 200° and 300°C. in the presence of a suitable catalyst.

The catalyst employed for the attempted conversion of the naphthenic acids was ferric oxide deposited on asbestos, and heated in a tube in an electric

furnace. The air in the tube was replaced by carbon dioxide to avoid oxidation and Caucasian naphthenic acids, boiling from 140°–190°/25 mm. and having an acid value of 220, were introduced drop by drop at one end of the tube. The reaction products which collected at the other end of the tube were found to consist of unchanged acids even after heating to 360°–370° C. in the presence of the catalyst. Working with the catalyst at 450° C. gave for the first day a product of acid value 47, which, however, increased to 60 on the next day and to 150 on the sixth day, the activity of the catalyst having been destroyed.

Eventually, from 525 gms. of the naphthenic acids, 340 gms. of product was obtained, having an acid value of 94. It was shown that ketones were not present to any extent in this product and that it consisted mainly of unsaturated hydrocarbons and compounds containing oxygen. S. F. B.

364. Industrial Requirements for Dry-cleaner Naphtha. Lloyd E. Jackson. *Ind. Eng. Chem.*, 1926, **18**, 237–238.

Although by no means an ideal solvent, motor gasoline has always been the most widely used dry-cleaning solvent, owing to its low cost and the ease with which it is obtained. In use it has several disadvantages; it is very volatile, considerable expense being incurred in replacing evaporation losses—and the vapours which escape are highly inflammable. The ideal solvent, however, must be reasonably volatile in order that it cn be easily removed by evaporation from the materials cleaned. Super-solvent powers are unnecessary as the cleaning power is dependent to some extent upon colloidal phenomena and not solely upon solvent power. Experience has shown that a petroleum product meets the requirements to the greatest extent.

The ideal product would be a straight-run well-refined naphtha boiling over a very narrow range, for example between 350 and 360° F. To make a product boiling within such a close range is unpracticable, but it has been found that a naphtha boiling between 280° and 400° F. forms a suitable dry-cleaning solvent. The specification for a suitable naphtha is as follows:—

(1) It must contain no undissolved water, be water-white in colour and possess a pleasant odour.

(2) It must give a negative doctor test, some naphthas having been observed to go off colour in use and in storage.

(3) Unsaturated hydrocarbons must not exceed 2 per cent. as they tend to impart an unpleasant odour to the naphtha and the article cleaned with it.

(4) The distillation ranges must fall within the limits of 280°F. and 400° F.

(5) The residue after distillation must not be acid as this would probably indicate the presence of sulphuric acid used when refining.

(6) Aromatic hydrocarbons give trouble by causing emulsions if present in any considerable amount and should therefore be absent. S. F. B.

365. A Vacuum Regulator. G. V. Schofield. *J. Ind. Eng. Chem.*, 1926, **18**, 717.

The device consists of a standard iron pipe 122 cm. long, 38 mm. dia., filled with mercury to a depth of 80 cm. Dipping into this reservoir a glass air tube can be adjusted to give the required pressure which is taken from a 5-litre flask placed between the mercury reservoir and the pump. This is necessary to absorb pressure fluctuations in the system due to the intermittent admission of air through the mercury column. With this apparatus it is possible to hold any constant pressure over prolonged operations.

S. B.

366. Oil Rectification. *Auto. Eng.*, 1926, **16**, 226–228.

The gradual lowering of the standard of petrol supplied in America, with its lower volatility, has made complete evaporation difficult. As a result a large amount of unburnt fuel passes the pistons and contaminates the crank-case oil, it being claimed that during winter the dilution averages 39 per cent. fuel and 1·6 per cent. water after 300–500 miles.

After a large amount of experimental work, the Skinner Automotive Device Co., of Detroit, have produced an oil rectifier, and this is now a standard fitting to a number of American cars.

A hole is drilled through each cylinder wall below the lowest ring when the piston is at the bottom, and intermittently registers with a groove communicating with the lowest piston ring groove. A small pipe connects these holes and conducts the diluted oil to an annular space in the upper chamber of the rectifier, which is surrounded by a jacket connected to the exhaust manifold. The contaminated oil rises to the top of the annulus and overflows into the inner chamber, by which time it is heated sufficiently to remove the dilution, and the gases are drawn off at the top and passed into the inlet manifold. The rectified oil passes through a valve into a lower chamber containing a float. When this chamber is full, the float closes the inlet and opens a vent valve, the oil flowing back to the crank case. The temperature to which the oil is heated is controlled by a thermostat. The only moving parts in the device are four valves. G. S.

367. Adsorption Studies on the Decolorisation of Mineral Oils. T. H. Rogers, F. V. Grimm and N. E. Lemmon. *Ind. Eng. Chem.*, 1926, **18**, 164-169.

Although the view that the decolorisation of mineral oils by porous materials is by adsorptive action is generally accepted, it has not been previously shown whether the laws of adsorption are actually obeyed.

The authors, from a study made of using a number of oils and adsorbent materials, have now shown that provided a suitable colour standard is selected, Freundlich's equation can be applied accurately to the colour adsorption. It is necessary however that great care be exercised in the choice of an oil for the standard colour measurements, as it has been shown that the use of a single oil in preparing a whole range of standard colours, to be used for various kinds of oil, only gives approximately accurate results. It is then possible if it is assumed that the colour removed is a measure of the material absorbed to estimate the adsorption accurately. The Freundlich equation has been found to afford a convenient means of accurately valuating the decolorising power of an adsorbent and is therefore of great use practically. It has also been found that the decolorisation of a partly decolorised oil gives results different from those obtained from the original oil, and that other factors, particularly the age of the oil, also affect the adsorption values. The results also show that whereas activated carbons are effective adsorbents for the darker coloured compounds contained in the heavier oils, they have little or no affinity for the colouring matters present in kerosene. Furthermore, silica gel was found to be a good adsorbent for kerosene refining when a colour of 21 Saybolt only was required, but that if a colour of 25 Saybolt was required, it proved a very poor refining agent. Clays, however, proved to be equally effective for refining the three different types of oil examined.

Experiments carried out using cracked kerosene showed that the colour which develops in the presence of fuller's earth and other adsorbents is due to oxidation and is catalysed by the adsorbent. S. F. B.

368. Improvements in or Relating to Apparatus for Preventing Evaporation From Liquid Storage Tanks. Standard Oil Co., E.P. 236,114.

The vapour spaces of storage tanks, containing volatile substances such as gasoline and crude oil, are connected to collapsible containers composed of fabric impervious to gasoline and crude oil vapours. S. F. B.

369. Relation Between Fuel-Deposition Temperature and Equilibrium Boiling Point. W. A. Whatmough. *Ind. and Eng. Chem.*, **18**, 6, 609–612.

A close relationship is found by the author between the equilibrium boiling point of a motor fuel and the temperature of fog formation in a 12:1 air fuel mixture. The temperature of fog formation was determined by vaporising the fuel in a special flash boiler with exhaust gases as a source of heat, and observing the mixture through a glass plate in the induction pipe. The 85 per cent. point on an Engler distillation is found to represent the equilibrium boiling point with sufficient accuracy. W. N. H.

370. Industrial Tests of Internal Combustion Engines. W. A. Tookey. Paper before Diesel Engine User's Assoc., April 9, 1926 (40 p.).

The tests referred to are those made at maker's works under supervision of purchaser's engineer. While the rated output is defined to be the load in b.h.p. which can be carried at rated speed for 12 hours, and for 1 hour with a 10 per cent. overload, the trials are generally carried through in a shorter time, as, 1 hour running for warming up and adjustment of details; 3 hours full output at rated speed; 1 hour overload output and 1 hour rated output, followed by trials to determine speed variation with load suddenly thrown on and off, and about ½ hour each at full load and at half to three-quarter load while checking power and fuel consumption. It is also of interest to note running and fuel consumption at quarter load and no load. After the trial pistons and rings, valves, etc., should be inspected. Starting trials are of particular importance when the same storage vessels are used for blowlamp pressure as for starting. Pressure and humidity of atmosphere should be checked by official meteorological records. For engines destined to operate at a considerable altitude the pressure on the engine side of air manifold is made to coincide with the corresponding barometric pressure. As dynamometers, rope brakes and Prony brakes require much adjustment and suffer from vibrational effects, the water dynamometer is most convenient for testing internal combustion engines. Reliable figures within the tolerance of 2½ per cent. are given by measuring the current from an electric generator by a dynamometer. Properly taken indicator diagrams are most instructive, it being easy to calculate volumetric efficiency from them. The net heat value of town's gas is about 90 per cent. of the gross value, for producer gas about 89 per cent., and for heavy liquid fuel about 83 per cent. Producer gas combustion mixtures have only 67 per cent. to 76 per cent. the heat of town gas mixtures. The weight of air that takes part in combustion cannot generally be accurately determined in engine tests. Numerous check readings of fuel consumption should be made throughout the trial. For speed variation trials a hand speed counter is preferable to a tachometer. Every engine test should include maximum and minimum speed trials to demonstrate the extent of hand regulation provided. It is recommended that every engine be fitted with a rating plate indicating maximum and minimum speeds. A considerable alteration in speed is equivalent to an alteration of the ignition timing, and may cause bumping or stoppage of the

engine. Surface ignition engines are very sensitive to temperature fluctuations on change of load, and require careful control. Timing of combustion in gas engines depends upon the mixture strength of the charge, the ignition advance, and the temperature of the walls enclosing the clearance volume. Air regulation, hardly necessary in heavy oil engines, is of great importance for the efficiency of gas engines. The author expresses thermal efficiency in units of pressure produced per heat unit consumed, this value, Tm, being Pm/Qt for i.h.p., or $Tn-Pn/Qt$ for b.h.p.; Qt being the b.th.us. per cub. ft. of cylinder volume plus clearance volume, and Pm representing the positive loop of the diagram in lbs. per sq. in. The Tookey factor value for gas and petrol engines is about 2·25 on the lower-heat values, and for the modern heavy oil engine about 2·7. Commercial guarantees are often given on the basis of lbs. or cub. ft. of fuel per b.h.p. hour, but true comparisons of thermal efficiency can only be made on the i.h.p. basis. Tables are given showing the properties of combustible mixtures and ratio of volumes and compression pressures, and graphs showing thermal efficiencies, mixture strengths, heat-work, and effects of throttle and ignition control.

H. M.

371. A Positive Drive Infinitely Variable Gear. *Petr. Times.* Sept. 18, 1926, p. 495.

The "Positive Drive Infinite Variable Gear" consists essentially of two specially constructed expanding pulleys connected by a driving chain.

The pulleys are of the opposed conical disc type sloping on the inner faces at an angle of 30° to the centre. These faces contain alternate ribs and grooves radiating to the hub, the ribs on one face being opposite the grooves on the other, in staggered fashion. The chain is engaged at the edges by the ribs which act as teeth in such a manner that the drive is just as positive and non-slipping as the ordinary roller chain and sprocket.

The links of the chain have a longitudinal slot punched in them, in order to hold a bunch of small vertical thin steel plates. These thin plates are attached so that they can move in a direction at right angles to the travel of the chain. They project at either side of the chain, and as a link enters the V of the pulleys, the ribs on one face push the requisite number of slats across into a groove of the other face. In this way, the chain always engages in all positions with the disc driving wheels, there being no motion of the slats once they are transmitting power. In order to alter the speed of the driven shaft, all that is necessary is to slide the halves of each of the split pulleys along to a very slight extent, using a common lever. On one shaft, the two halves are brought closer together and the chain has to rise in the grooves, while the other pulley being correspondingly widened out, causes the chain to fall deeper in the grooves. In this way the speed alteration between the two shafts is infinite, and also perfectly smooth in action, while the whole arrangement may be contained in a box of small size, running in oil, and impervious to outside influences such as heat, dust, etc.

W. H. T.

372. The Supercharging of Diesel Engines. *Gas and Oil Power*, 1926, 21, 189. (Paper by S. A. Moss before Amer. Soc. Mechanical Engineers.)

Without supercharging, or forcing air by a compressor or blower into the cylinder, the pressure at the beginning of compression would be below atmospheric in four-cycle engines. In two-cycle engines supercharging implies an increase in the pressure of scavenging air, and there must be some valve arrangement which permits of additional charging after the exhaust ports

are closed. If the inlet and exhaust valves have a proper lap the air charge is greater than the clearance volume, with a cleaner charge and better combustion, and a decreased air excess. The percentage of heat carried away by the cooling water is decreased; an increased amount of power is attained with given friction, and the expansion of an increased charge to a given final volume causes a decrease in the area of the theoretical indicator card. A supercharging pressure above atmospheric of 1–5 lbs. per sq. in. increases the amount of charge 6–30 per cent. Great increase in engine power has been obtained in recent German installations by supercharging of only 400 to 600 mm. of water. A slight loss results theoretically from the fact that the supercharged engine does not expand the gases to as low a pressure as the normal engine. The success of supercharging depends upon the engine being able to carry the extra power without trouble with valves, etc.; it has been adopted on U.S. aeroplanes; the use of special steel alloys permitting valves to operate at temperatures greater than those met with in Diesel engines. On two-cycle Diesel engines supercharging is best effected by centrifugal compressors, which may be successfully driven by exhaust gas turbines.

H. M.

373. New Design of Two-Stroke Double-Acting Diesel Engine. *Gas and Oil Power*, 1916, **21**, 197–199.

Messrs. Richardsons Westgarth & Co. have recently turned out a new design of two-stroke double-acting oil engine. The cylinder is of 26 ½ in. bore, with piston speed of 710 ft. per min., producing 800 b.h.p., and a unit may consist of nine cylinders. The injection is by a solid injection controlled pump system. The normal speed is 90 r.p.m. The weight per b.h.p. is 172 lbs. for 3-cylinder to 115 lbs. for 6-cylinder (at 125 r.p.m.), or 145 and 105 lbs. respectively excluding flywheel, thrust block and after bedplate. The engine is designed to reduce heat and mechanical stresses to a minimum. The port scavenging system is independent of the piston and cylinder cover, and the upper and lower cylinder covers and valves are interchangeable. An ample scavenge air receiver is embodied in the scavenge side of the cylinder and the exhaust half of the casing is water-cooled. The liner is held at the centre by the upper cylinder jacket and has patent alternate scavenge ports. Top and bottom covers are ribless, a central hole accommodating the starting air valve in the top cover and the piston rod in the lower cover. There are two cast iron single acting pistons of identical construction. Special cast nozzles distribute the cooling water about the piston. The piston gland has a long water-cooled annular passage so that only cooled gases reach the gland. The top and bottom combustion spaces are annular with flat ends to give a compression pressure of 350 lbs. per sq. in. All mechanically, operated valve gear about the cylinders is replaced by a compact unit about the floor level. Separate fuel pumps are provided for each cylinder end.

H. M.

374. The "Plenty-Still" Engine. Anon. *Gas and Oil Power*, 1926, **21**, 262.

In the Still engine exhaust heat and heat from the cylinder of a normal two-stroke internal combustion engine are used to generate steam which is used to operate on the lower side of the piston (the lower part of the cylinder being enclosed and provided with cam-operated valves), thus adding to the efficiency of the machine. A short description is given of an engine of this type produced by Messrs. Plenty and Son, Ltd., Newbury. This engine, of 130–150 b.h.p., has cylinder bore and stroke of 370 mm. and 450 mm. respectively. It is built in 2, 3, 4, 5 and 6 cylinders, for speeds of 220–250

r.p.m. The maximum steam pressure is 150 lb. per sq. in. The introduction of steam at the cold end of the cylinder minimises the temperature gradient between the cylinder ends, thereby, it is claimed, affecting favourably both capital and maintenance expenses. Moreover, as a result of the higher initial cylinder pressure, the compression pressure is considerably reduced.

Inlet and exhaust on the internal combustion side of the piston are controlled by ports on opposite sides of the cylinder. The piston top slopes downwardly towards the exhaust side, enabling the exhaust to be discharged before the air-inlet port is opened. Fuel feed is of solid injection type. The fuel inlet is by means of a valve (mounted in the centre of the cylinder cover) housed in a case held by four springs on seatings in the cylinder cover, thus forming a cylinder relief valve. A specially designed cam-operated pump is attached to one end of the crank chamber. A unique feature is constancy of the fuel pressure during the whole period of injection; moreover, the injector is only under pressure during the injection period.

A small auxiliary boiler provides steam for starting and manœuvring; if desired, the engine may be run indefinitely at low speeds on steam alone.

W. S. N.

375. Motor Fuel Value of Natural Gasoline. E. H. Leslie and G. G. Brown. *Oil and Gas Journal*, **25**, No. 3, pp. 120, 121, 132.

A series of tests were carried out on a variety of internal combustion engines to examine the behaviour of blends of natural gasoline with straight-run gasoline. The following results were obtained: the greater the proportion of natural gasoline in the fuel the more easily does the engine start. As regards acceleration: with a cold manifold or one heated to a limited extent only, the best acceleration is obtained with the more volatile fuel; with a manifold exposed to the full heat of the exhaust the best acceleration is obtained with a fuel having a volatility equivalent to that of 15 to 30 per cent. natural gasoline: for acceleration at extremely low speeds the more volatile fuel is desirable.

Anti-knock properties of the various blends were determined by using a bouncing pin apparatus on a fixed compression engine and inducing knocking by varying the spark advance; in general it is concluded that natural gasoline blended with straight-run gasoline is equivalent to two-thirds as much benzol in blends containing not more than 50 per cent. of natural gasoline.

It is noted that when two fuels under one set of conditions give identical intensities of pinking, these intensities cannot be assumed to be the same under another set of conditions.

W. N. H.

376. Carbon Deposit and Gasoline Quality. S. P. Marley, C. J. Livingstone and W. A. Gruse. *Oil and Gas Journal*, 1926, **25**, 4, 162–163.

The three factors believed to be responsible for carbon formation have been studied experimentally, all operating conditions except the one under study being kept constant. The apparatus used was an 850-watt Delco generating plant, the air-cooled head being replaced by water-cooled head carrying a thermo-couple well. The air-cooled cylinder was used interchangeably with a water-cooled cylinder and the crankcase bottom was replaced by a water-jacketed sump. Arrangements were made for circulating a small charge of oil, permitting the observation of small variations in consumption, and fuel was supplied through a small carburettor and controlled by timing the flow of a measured volume. The air to the carburettor and the water to the engine were kept at definite temperatures, and the load on the generator was controlled by resistances, the speed of the engine being observed by a revolution counter.

In starting a test the apparatus was brought to selected conditions as quickly as possible and maintained constant throughout, and the accuracy of control was such that power output was constant to within an average of 1 per cent. On completion of a run the oil was allowed to drain, the engine dismantled, and the carbon recovered. Seven different fuels and six lubricating oils were used, their characteristics being given.

Full details are given of the carbon deposits in the cylinder head under varying conditions, and in conclusion it is considered that the oil which leaves the least residue on evaporation from the metal surfaces will give the least trouble from combustion chamber deposits. G. S.

377. Motor Fuel Mixture. J. E. Babb, Assr. to Waverly Oil Works Co. U.S.P. 1,579,801-2-3, April 6, 1926. Appl. Dec. 15, 1924.

An organic acid, soluble in gasoline, is added in sufficient quantity to combine with oxide of lead, which is also added. The organic acid may be a distillation product of rosin and renders the lead volatile. S. B.

378. Motor Fuel. E. F. Chandler. U.S.P. 1,597,343, Aug. 24, 1926. Appl. 21.11.24.

A fuel for internal combustion engines consists of mixture of gasoline dimethyl ketone, and water. S. B.

379. Motor Fuel. H. L. Elliott. U.S.P. 1,587,899, June 8. Appl. 31.1.20.

The fuel consists of aromatic hydrocarbon distillates, free from sulphur, and petroleum distillates, both boiling not over 300° F., and not more than 7 per cent. in all of a volatile monohydric alcohol, a readily volatile terpene compound, naphthalene and water. The product is a homogeneous stable mixture. H. M.

380. Alcohol-Ether Motor Fuel. A. P. Mackilligan and F. Garland. E.P. 251,157, Aug. 19, 1925.

A motor spirit is proposed consisting of an alcohol ether mixture varying between the ratios 7:3 and 3:7, according to the compression ratio employed. To this mixture is added 0.5 per cent. pyridine, 0.5 per cent. caoutchoucine, 1 per cent. kerosene, by volume. These additions act as denaturants and the first also as a neutralising agent. Caoutchoucine is obtained by the distillation of crude rubber at 176° C. S. B.

381. Fuel. T. Midgley, jun., Assr. to General Motors Corp. U.S.P. 1,592,954 of July 20. Appl. of May 19, 1923.

A homogeneous motor fuel and an anti-knock substance containing lead and a substance which combines with the lead during combustion forming a compound having a lower fluxing action than lead oxide. H. M.

382. Preparation of Fuel Oil. E. A. Rudigier, Assr. to Standard Development Co. U.S.P. 1,597,292, 24.8.26. Appl. 21.11.24.

The viscous sludge obtained from the acid treatment of hydrocarbon oil is mixed with a less viscous fuel oil of approximately similar specific gravity as the acid sludge. S. B.

383. Process of Improving Motor Fuel. D. R. Stevens, S. P. Marley and W. A. Gruse, Assrs. to Gulf Refining Co. U.S.P. 1,593,040 of July 20. Appl. 28.12.25.

A material containing an aluminium halide is treated with a combustible organic liquid. The liquid is then added to motor fuel to improve it as regards knocking qualities. H. M.

Analysis and Testing.

384. Hydrocarbons [Aromatic, Estimation of ——] in Natural Gasolines. A. M. Erskine. *Oil and Gas Journal*, 1926, Aug. 19, pp. 144–145.

The following procedure is adopted for estimating the content of benzene, toluene, and xylene in gasoline.

A known volume of the sample (300–500 c.c.) is fractionated, using the most efficient column available, into the fractions: 50°–95°, 95°–124°, 124°–150° C. (or residue above 124° C.), at 760 mm. After treating with mercuric acetate to remove olefins, a 25–50 c.c. portion of each fraction is shaken with two volumes of 98 per cent. sulphuric acid for 10 mins. (20–30 mins. for the first fraction). The hydrocarbon is then washed with water, with sodium hydroxide solution, and again with water, after which it is dried over calcium chloride. The critical solution temperatures are now determined of each of the original fractions, and of each of the aromatic-free fractions, using an equal weight of pure, dry nitrobenzene. Closed tubes are preferable for this operation, which is carried out in any apparatus which will give vigorous shaking and a controlled slow rise or fall in temperature. The rise in critical solution temperature (after deducting 0·60° C. and 0·52° C. from the observed rise, for the toluene and xylene fractions, respectively) is multiplied by 0·845 for the benzene, 0·890 for the toluene, and 0·938 for the xylene fraction, this giving the percentage by weight of the aromatic hydrocarbons in the corresponding fractions. Knowing the ratio between the weight of each fraction and that of the original sample, the percentage of each aromatic hydrocarbon in the latter may then be calculated.

The method offers the advantages that the temperatures used are lower than those employed using aniline, and that a precision can be attained such that the percentages found are accurate to within 0·2 per cent. W. S. N.

385. New Method for Determination of Softening Point of Pitch, Asphalt, etc. F. G. Hoffmann. *Petroleum Zeitschrift*, 1926, 7, 218–220.

The method of Krämer-Sarnow, which has hitherto been of general use throughout Germany, is troublesome, inconvenient, and inaccurate. A method has now been devised which depends upon the penetration of the sample by a blunt needle of known weight, the temperature at which this occurs being taken as the softening point. The pitch is hand-pressed into a small lead cup (holding about 0·15 gm.), which is suspended in one of two recesses in a small aluminium block; the needle (which is 1·5 mm. diameter and the tip of which is rounded), loaded to a total weight of 15 gm., rests, in a guide, on the surface of the sample. A thermometer is fitted in the second recess in the aluminium block, which is heated by a small, free flame at a rate depending on the softening point (known approximately) of the pitch. The rates of heating recommended are 1°, 2°, 3°, 4°, 5°, and 6° C., per min. respectively, when the softening points are: below 40°, up to 80°, 120°, 160°, 200°, 240°C. It is also recommended that the aluminium should be brought

to within 20° of the anticipated softening point of the sample, previous to the introduction of the latter. The temperature is then read at which the needle has descended 10 mm. into the sample. W. S. N.

386. Volatility Test for Automobile Fuels. T. S. Sligh. *Oil and Gas Journ.*, Aug. 1926, p. 72.

The test has been devised as a means of measuring the volatility of a fuel under conditions similar to those obtaining in an internal combustion engine. The air and fuel are delivered at measured rates to an evaporating coil maintained at any desired temperature, and the amount of unevaporated liquid measured. The air supply is measured by means of a calibrated orifice and manometer and the fuel is displaced from a reservoir by means of a plunger actuated by clockwork. The evaporator consists of a spiral 4 in. diameter made from 16 ft. of $\frac{1}{16}$ in. metal tubing, the unevaporated fuel draining into a graduated receiver. Plotting the percentage of fuel evaporated against various temperatures, a distillation curve is obtained for any given air-fuel ratio. The results obtained by this method are considered to have a greater bearing on engine performance of a fuel than the usual distillation test.

The results obtained on a large number of gasolines are given for example under starting and normal running conditions.

Fuel No.	Percentage evaporated at 32° F. (air fuel 4 : 1)	Percentage evaporated at 131° F. (air fuel 15–1)
1 ..	10 % ..	86·0%
2 ..	40 % ..	97·0
3 ..	15 % ..	89·5
6 ..	16·5% ..	94·5%
7 ..	24·3% ..	—

S. B.

387. The Oxygen Bomb Method for Sulphur Determinations. M. J. Bradley, R. M. Corbin and T. W. Floyd. *Ind. Eng. Chem.*, 1926, **18**, 835.

The conditions prevailing during the combustion of organic materials in the calorimetric bomb led the authors to believe that the sulphur present would be incompletely oxidised and thus gave low results. Experimental work verified this and showed that the percentage of sulphur dioxide present ranged from 14·5 to 43 under varying pressures of oxygen used. It was found that presence of nitrogen oxides provided an activating atmosphere in the bomb, and if present in sufficient quantity complete oxidation of the sulphur to the trioxide resulted.

It is therefore suggested that ammonium nitrate should be added to the charge in quantity to give a nitrogen content 5 per cent. of the sulphur content, under which conditions complete oxidation is assured.

The addition of ammonium nitrate also promotes the combustion of the heavier oils, tars, pitches and asphalts. S. B.

388. Fire Point Carbon Test. R. M. Byrd and F. C. Vilbrandt. *J. Ind. Eng. Chem.*, 1926, **18**, 699–700.

An important feature of lubricating oil used in automobile engines is the formation of carbon deposit on the cylinders and pistons. Such deposits may be caused by the mechanical and running conditions, but are also due to certain properties of the oil used. According to the authors, oxidation leads to the formation of asphaltic bodies which are precipitated by gasoline dilution and subsequently change to the carbonaceous matter found. In

devising a test to show this property the Conradson Coke Test is not considered suitable as the conditions of this test are not simulated in an internal combustion engine. The proposed test consists in heating the oil to its fire point in the Cleveland Open Cup Tester, and after cooling the oil is diluted with 50 cm. of gasoline. The precipitate is then filtered through a Gooch crucible, washed with 250 cm. of gasoline, dried at 105° C. and weighed.

The results obtained from a number of oils are tabulated together with the other essential characteristics. For heavy oils the fire point carbon is ·01–·011 per cent., ·006–·009 per cent. for medium, and ·004–·005 per cent. for light oil. It is claimed that this test shows fewer irregularities than the Conradson test and is cleaner to operate. S. B.

389. Terminating Charcoal Tests of Gas. By F. L. Kallam. *Oil and Gas Journal*, 1926, 25, 120.

The writer deals with a method by which the maximum gasoline content of a gas may be determined without danger of under or over-saturating the charcoal when even an approximate content of the gas is unknown.

The correct termination point is determined from the temperature rises and falls in the charcoal due to the adsorption and displacement of the various hydrocarbons. There are at least four temp. rises and falls characteristic of all wet gases; the peak points represent saturation of the charcoal by one constituent, and the temperature fall by replacement of such a constituent by a heavier one.

The author concludes that:

1. It is possible to fractionate the hydrocarbon constituents of natural gas by the use of activated charcoal.

2. Commercial natural gasoline contained in gas means gasoline containing butane and all heavier hydrocarbons present in gas.

3. There is a definite relation between the volume of gas sampled and the amount of charcoal used in order to obtain a maximum test of the commercial natural gasoline in the gas.

4. For atmospheric pressure and 32° F. condensation, the maximum test for wet gas will be obtained in all cases between the fourth and 1·25 times the fourth saturation point for any particular gas and any particular amount of charcoal. This assures of neither over nor under-saturating the charcoal. For gases ranging between 0·5 and 2·5 gallons content, the test should be terminated at 1·25 times the fourth saturation point. For gases ranging from 2·5 gallons and upwards, the test should be terminated at the fourth saturation point.

5. When condensing under 45 lbs. per sq. inch abs. and 60° F. all tests may be stopped at the fourth saturation point. This method will give higher results than will atmospheric condensation. A. W. G.

390. Determination of Specific Gravity of Natural Gas. *The Refiner*, vol. 5, No. 8, p. 38. Guy S. Mitchell.

In this and subsequent papers four methods for the determination of specific gravity of a gas are to be considered in detail. The methods are, the effusion method, gas density balance, direct weighing and calculation from analysis. In the present paper the corrections to be applied in using the effusion method are discussed. Since the effusion method is most useful on account of the ease of handling the apparatus it is desirable to use water rather than conc. H_2SO_4 as the confining agent. In this case inaccuracy is introduced owing to the fact that both the air and gas are saturated with water vapour.

If S_g denotes the specific gravity of the saturated gas, *i.e.*, the "apparent" specific gravity, and S denotes the specific gravity of the dry gas, *i.e.* the "true" specific gravity:—

$$S_g = \frac{S + K}{I + K}$$

where the constant K is given by

$$K = \frac{\Delta_w + p_w}{\Delta_a (p - p_w)}$$

Δ_w = density of water vapour
Δ_a = density of air
p_w = partial pressure of water vapour
p = total pressure of air (or gas) + water vapour.

(For proof see Technological Paper No. 94 Amer. Bur. Stand.)
The values for K at 760 mms. and various temperatures are :—

Temperature °C	K
0	·004
5	·005
10	·008
15	·011
20	·015
25	·020
30	·027
40	·048
50	·086
60	·151

S_g is found by timing the efflux of air (t_1 secs.) and the gas (t_2 secs.) and using the formula

$$S_g = \frac{t_2^2}{t_1^2}$$

The true specific gravity is then obtained by substituting in the above formula.

A correction table of specific gravities is given, and two tables demonstrating the accuracy of the method at temperatures of 30°–60° C. The apparatus is only briefly described. An accuracy of 1–1·5 per cent. is obtainable.

P. D.

391. THEORETICAL AND RECORDED PRESSURES IN OXYGEN BOMB DETERMINATIONS. M. J. Bradley, C. L. Rosecrans and R. M. Corbin. *Ind. Eng. Chem.*, 1926, **18**, 307–309.

The combustion of substances in the oxygen bomb always develops a smaller pressure than that to be expected from theoretical considerations, a fact which is accounted for by the influence of certain factors, such as the rate of combustion, for which no adequate allowance can be made. It is therefore impossible to calculate the margin of safety actually existing during any combustion or to lay down conditions giving a safety limit when any material is being burnt under any definite conditions of combustion. From data obtained during the combustion of different weights of crude petroleums, oil,

benzene, kerosene and benzoic acid in the oxygen bomb, the authors have found that if a heat equal to half the heat of combustion of the fuel up to the time of maximum pressure is assumed, a theoretical pressure can be calculated which will be safely above any pressure actually developed. Conversely, using the same assumption, it is possible to estimate the weight of fuel and the initial pressure of oxygen which can be safely employed. The authors have also evolved a method for the determination of carbon and hydrogen by means of the bomb. If the volume of the bomb and gauge is accurately known, the percentage of carbon dioxide in a definite volume of the resulting gases estimated by means of an Orsat apparatus gives the percentage of carbon present. Also, by cooling the bomb and measuring the increase in volume, the percentage of hydrogen can be read directly from the gauge. S. F. B.

392. Estimation of the Unsaturated Content of Petroleum Products. A. W. Francis. *Ind. Eng. Chem.*, 1926, **18**, 821–822.

The usual methods for estimating the unsaturated content of petroleum products by means of bromine or iodine have never been quite satisfactory, chiefly owing to substitution occurring simultaneously as well as the difficulty experienced in keeping the necessary standard solutions. To overcome such difficulties the authors have devised a method in which a standard solution of potassium bromide and bromate, which is unaffected by keeping, is employed. This solution generates bromine when acidified sufficiently slowly for it to remain at a low concentration, an important fact if reliable results are required, for then substitution is not likely to occur. The method is as follows: A slight excess of the bromide-bromate solution, preferably not more than 1 c.c. (estimated by a trial titration), is placed in a flask and a definite quantity of the oil pipetted in. 5 c.c. of sulphuric acid (10 per cent.) are then added, and the whole vigorously shaken. The contents of the flask should remain pale yellow: if the colour becomes dark in spite of vigorous shaking, too much of the bromide-bromate solution has been taken, and the result will be high. Finally, another 15 c.c. of the acid are added and, after shaking for another minute, the excess of bromine is estimated in the usual way by means of standard thiosulphate solution. The bromine number is then given by the expression:—

$$N = \frac{0{\cdot}08}{V\,D}\,(T_1N_1 - T_2N_2)$$

Where N is the bromine number in gms. per gm. of sample, V and D are its volume and density respectively, T_1 and N_1 the volume and normality of the bromide–bromate solution, and T_2 and N_2 the volume and normality of the thiosulphate. In order to determine the olefine content of a gasoline from this number, the average molecular weight must be known. For a narrow cut of a distillate this can be approximately estimated from the mean boiling point, and is given roughly by adding 54 to half the mean boiling point in degrees Centigrade. The olefine content is then obtained from the expression:

$$V = \frac{M\,N}{160}$$

Various applications of the method and tests carried out on gasolines containing definite quantities of pure unsaturated compounds are described. S. F. B.

393. An Improved Laboratory Fractionating Column. A. W. T. Loveless. *Ind. Eng. Chem.*, 1926, **18**, 826.

The efficiency of a fractionating column is almost entirely dependent upon four factors:—(1) Thermal insulation of the column; (2) ratio of reflux to distillate; (3) intimacy of contact between vapour and reflux in the column; (4) length of the column. Of these the usual laboratory column only gives (3); the most efficient column yet described is probably that of Peters and Baker (*Ind. Eng. Chem.*, 1926, **18**, 69). The author has found that with slight modification this column can be greatly simplified without impairing its efficiency. The modified column is surrounded by a silvered jacket and the intervening space highly evacuated. Small glass rings, consisting of ¼-inch pieces of glass tubing, ¼ inch in diameter, are used as packing. The still head is entirely composed of glass and is fused on to the column. It consists of a reflux water-cooled condenser to which is sealed a glass stop-cock in such a manner that the volume of condensate returned to the column can be carefully regulated; the rest is passed into the receiver. Results obtained with this column are given. S. F. B.

Distillation and Refining.

394. Distillation Studies. E. H. Leslie and J. G. Geniesse. *Ind. Eng. Chem.*, 1926, **18**, 590–6.

The performance of a specially designed laboratory fractionating column is described in detail. The apparatus consists of a two-litre Pyrex glass flask with a bulb blown on the bottom and fitted internally with a resistance coil which supplies the heat for distillation purposes. The flask is surmounted by an insulated and jacketed column, which is filled with Lessing rings and on which is adjusted a still head with side tube leading to a condenser, a thermometer, an orifice meter for measurement of reflux liquid and a reflux condenser. The thermal efficiency of all parts of the apparatus was first determined. The characteristics of the system chloroformtoluene were then studied and data necessary for the rapid analysis of these solutions presented. The influence of vapour velocity and diameter of column packings was also investigated. H. G. S.

395. Fractionating Column Calculations. T. S. Carswell. *Ind. Eng. Chem.*, 1926, **18**, 294–295.

From theoretical considerations the author has deduced the following equation for packed columns:—H.E.T.P. = Cr. Where H.E.T.P. (the "height of the equivalent theoretical plate") is the length of packing required to produce the same effect as one perfect plate (Peters, *Ind. Eng. Chem.*, 1922, **14**, 476), r is the mean radius of the packing ring and C is a constant. From this equation it follows that for the same liquids and the same pressures of distillation the length of packing required varies directly with the radius of the packing rings. Peters observation (*loc. cit.*), that the H.E.T.P. varies with the nature of the liquids under separation and that it is greater for liquids of high molecular weight is explained on the basis of the assumption made in deducing the equation, that the H.E.T.P. varies indirectly as the surface of the backflow and directly as the volume of the vapour. As, at the boiling point the volume occupied by a unit weight of the substance is directly proportional to the molecular weight, it follows that with a substance of high molecular weight, the backflow coming into contact with a definite volume of vapour is less than the volume of backflow

in contact with the same volume of vapour of a substance of low molecular weight. Greater contact surface is therefore necessary. Figures for the constant C and for the H.E.T.P. calculated from Peters' data are given. S. F. B.

396. Condensing System. E. J. Atkisson, Assr. to Southwestern Condenser Co., U.S.P. 1,595,334, of Aug. 10. Appl., Nov. 1, 1922.

Mixed vapours are condensed fractionally in a series of condenser units, the vapour from one unit being fed to the next one. Each unit comprises a number of cooling tube divisions, which may be connected in series or in multiple. A common cooling system passes cooling fluid through the units in series. H. M.

397. Fractionation of Hydrocarbon Oils and like Liquids. R. H. Crozier. U.S.P. 1,583,340, 1926. Appl. 7.7.25.

In the distillation and fractionation of oils and other liquids, the vapours are caused to travel upwards through a column which is fitted internally with coils containing hot fluid and then downwards through another column containing cooling coils. A series of such columns may be employed. Collecting boxes for the retention of condensed liquid are provided at the base of each column and are arranged in cascade fashion. Baffles are also inserted to confine the vapours to flow from one column to the next. H. G. S.

398. Method and Apparatus for Distillation. W. E. Chenot. U.S.P. 1,584,730.

The apparatus comprises a still and a series of dephlegmators which are so arranged that the heated vapours leaving the still pass into a dephlegmator where they are partly condensed, the condensate returned to an internal receptacle situated in the still and within the heated liquid, there it is partly revaporised, but without contact with the original liquid. The vapours from the dephlegmator and from the revaporised liquid are collected in a common receiver. An arrangement is described having several dephlegmators and reheating receptacles. S. F. B.

399. Fractionally Distilling and Condensing. E. M. Clark and F. A. Howard, Assrs. to Standard Development Co. U.S.P. 1,595,642.

A method of fractional condensation is claimed in which the oil vapours from the still are passed through a number of condensers or heat exchangers, into one of which hot water is introduced in indirect contact with the oil vapours and travelling in the same direction. The water is converted to steam, which is passed to another heat exchanger through which the oil vapours pass in indirect contact, before entering the first condenser Water, at approximately its boiling-point, is mixed with the steam before it enters the second condenser, and the mixture passed through this condenser in the opposite direction to the oil vapours. G. S.

400. Apparatus for Treating Oil. G. Egloff and H. P. Benner, Assrs. to Universal Oil Products Co. U.S.P. 1,595,179 of Aug. 10. Appl. Aug. 20, 1920.

The apparatus has a rotary still member and a stationary still member, with a transfer line connecting them. The upper part of each member may be independently heated, the vapour taken off from one member, and a pressure maintained on the members. H. M.

401. Apparatus for Refining Hydrocarbon Material. F. M. Floyd. U.S.P. 1,587,370.

The apparatus described consists of a cylindrical still fitted with a flat false bottom of wire netting, the function of which is to prevent any solid formed within the still from reaching the bottom and causing excessive coking. It is claimed that this arrangement considerably lengthens the period over which the apparatus can be continuously operated without cleaning. The vapour line from the still is attached to a reflux chamber in which the hot vapours are partly condensed by the crude material which is passed through a coil in the chamber, but which does not come into actual contact with the heated vapours. It is claimed that this method is more satisfactory than one in which the vapours come in actual contact with the crude material. In this process the untreated material also becomes pre-heated. The volatile vapours escaping from this analyser pass into a condenser where they are cooled and separated from the more volatile in the usual way. S. F. B.

402. Distillation (Topping) Plant for Crude Oil. C. F. Hanson and P. Vanderveort. U.S.P. 1,597,375, 24.8.26. Appl. 29.12.22.

The still consists of a vertical oil passage fitted with a number of convex plates which tend to divide the oil flow into two streams. Adjacent gas passages are provided above each plate. S. B.

403. Improvements Relating to the Transport and Distillation of Mineral Oils, Tar Oils and Tars. G. E. Heyl. E.P. 253,436 of Dec. 15, 1925.

The oil or tar is distilled in the tanks of tank steamers or barges by steam heat during transit. The tanks are heat-insulated and subdivided for the concentration of the heating on portions at a time. Heating is effected by a steam coil or other surface heat exchanger, and exhaust steam may be utilised in the initial stage, live steam being used after. The vapours may be used to preheat the raw material, being afterwards condensed and stored in separate compartments. H. M.

404. Petroleum Still. L. J. Husted, Assr. to F. L. Rounsevel. U.S.P. 1,596,660 dated 4.3.20, renewed 28.12.25.

A series of horizontal cylindrical stills are connected end to end, division walls being left between the adjacent stills. A group of pipes runs parallel to the axis of the stills from end to end of the series. A hot liquid is forced through the pipes, In each still petroleum is sprayed upwards against the hot pipes, the vapours are condensed separately and the residue is drawn off. W. N. H.

405. Steam Distillation. F. A. Howard and E. M. Clark. Assrs. to Standard Development Co. U.S.P. 1,594,957.

A continuous system of distillation is claimed in which steam is introduced into the stills which are at a temperature of over 500° F. The vapours from these stills are cooled and from them vapours containing at least 50 per cent. of steam are withdrawn and compressed. The compressed vapours are introduced into the stills which are at a temperature below 500° F., and from these stills vapours are removed and condensed. G. S.

406. Oil (Coking) Still. J. O. Jenson. U.S.P. 1,597,469, 24.8.26. Appl. 20.1.21.

The bottom of a cylindrical still is reinforced by a number of interior longitudinal beams, which also serve to distribute heat to the contents of the still. S. B.

407. Still-Cleaning Device. W. Knapp. U.S.P. 1,595,666.

In a vacuum oil still, efficient cleaning of the inner surface is obtained by means of a brush attached to a shaft carried axially in the still through bearings in the still heads. G. S.

408. Apparatus for Distilling Oils. L. E. Lee. U.S.P. 1,594,294 of July 27. Appl. Nov. 9. 1921.

The still has a vertically disposed inner shell, against the upper end of which a spray nozzle projects a jet of oil, and from which the oil is projected on to a dome situated above the upper end of the shell. The oil is atomised by its impact against the dome, and thence directed to the outer surface of the inner shell. The shell is heated to vaporise the oil passing over it. An outer shell surrounding the inner shell forms a space to receive the vapours. H. M.

409. Process of Distilling with Aluminium Chloride. A. McD. McAfee. U.S.P. 1,579,050. March 23, 1926.

The heat utilised in the usual process of treating gas oils, etc., with aluminium chloride at 500° to 550° F. is reduced by preventing subsequent condensing and refluxing of the kerosene products containing volatilised aluminium chloride. Means are provided for condensing both, allowing the aluminium chloride to settle out and then returning the latter alone to the still. A. W. G.

410. Process of Removing Aluminium Chloride Residues from Stills. A. Mc.D. McAfee. U.S.P. 1,578,053. Mar. 23, 1926.

Residues in stills after the use of aluminium chloride are cooled with oil, the oil is run off, steam is introduced if necessary to expel inflammable vapours, and the residue is wetted with water. The whole is flushed out with water. A. W. G.

411. Process of Improving Oils. A. Mc.D. McAfee. U.S.P. 1,578,051. Mar. 23, 1926.

In the methodical utilisation of aluminium chloride in the improvement of oils, the process which comprises distilling heavy oil with aluminium chloride in a suitable still, until some, but not all, of said oil is distilled away; aluminium chloride volatilised during the distillation is condensed and returned to the still. The residual oil and chloride sludge formed in the distillation are transferred to a second still, the first still being replenished with fresh oil. The transferred oil is redistilled in the second still to remove active chloride therefrom, the vaporised chloride being condensed and returned to the first still; the oil and stripped sludge are removed from the second still. A. W. G.

412. Heat Transfer System. A. E. Nash and J. S. Alcorn. U.S.P. 1,591,431.

Heat is generated and divided into radiant and convection components. The fluid to be heated passes through the various stages in succession, enclosed and without contact with the surrounding atmosphere. G. S.

413. Apparatus for Treating Hydrocarbon Oils. O. Behimer. U.S.P. 1,582,893.

Oil is passed through a heating coil into a treating vessel of special design. The vessel consists of a vertical cylindrical shell containing a heating element which consists of a continuous coil insulated from the shell and supported on a central core. The shell of the still is enclosed in removable or adjustable insulation in the form of a plurality of doors, constructed of galvanised iron and lined with asbestos. Alternately the adjustable lagging may be in the form of a telescopic sleeve. Thus prevention of loss of heat, ease of inspection, and rapid cooling of the plant are provided for. R. P.

414. Apparatus for Refining (Petroleum) Oils. D. Pyzel, Assr. to Simplex Refining Co. U.S.P. 1,583,746 of May 4. Appl. of Oct. 26, 1921.

The cold oil to be refined is delivered to the top of a tight shell containing means for spreading and dividing the oil. The vapours from a still are passed upward through the shell in intimate contact with the oil passing downward, which condenses and absorbs a portion of the vapours. A portion of the oil is withdrawn and delivered to a cooler. The cooled oil and condensates may be delivered into the top of the shell, and oil with condensates may be passed from the bottom of the shell to the still. H. M.

415. Apparatus for Fractionating Petroleum. H. P. Strauss. U.S.P. 1,562,009.

A form of plate column in which each section is divided from the next by a perforated plate bearing a layer of contact material. Excess of condensate is returned to the next lower section by means of pipe fitted with a vapour seal. S. F. B.

415A. Process of Continuous Rectification of Spirits, Petroleum and Benzols. E. A. Sarbet. U.S.P. 1,559,218.

The more volatile constituents are removed at atmospheric pressure and the residual liquid then distilled under reduced pressure, at first without, but finally with, application of heat. S. F. B.

416. Apparatus for Distilling Hydrocarbons. M. J. Trumble. U.S.P. 1,586,130. 25.5.26. Appl. 16.4.23.

Crude oil is passed continuously through a heat interchanger, thence to two retorts in series, from which it is carried to a separator. Within the separator is a short cylinder resting on a transverse annular plate of diameter equal to that of the separator; the oil from the retorts is brought into a circular pipe, having downwardly directed vents, which is situated in the annular space between the cylinders and the walls of the separator. Oil overflows from this annular space in a thin film, down the interior surface of the cylinder. Residual oil collects in the base of the separator, which is provided with open steam and with a float actuating automatically a discharge valve, whereby the residual oil is allowed to pass to the heat interchanger. Open steam is also introduced into the incoming oil, between the first and second retorts, the quantity being automatically regulated by the pressure within the separator. The volatile constituents of the oil pass through a baffle system to the discharge pipe at the top of the separator, thence to a vapour turbine. W. S. N.

417. Apparatus for Refining Oils. M. J. Trumble. U.S.P. 1,586,132.

An apparatus for refining or cracking very heavy oils is described, which, it is claimed, operates without the trouble usually caused by deposits, *i.e.*, pitch, coke. Any deposit produced is removed from the heating zone as soon as produced. Essentially the apparatus is an evaporator. It consists of two horizontal cylinders, the inner of which is capable of rotation about its horizontal axis (being supported by two bearings). One bearing is insulated from the rest of the apparatus and it is therefore possible to heat the whole internal cylinder to any desired temperature by applying a suitable electromotive force to the bearings (*e.g.*, a cylinder 10 ft. long requires a current of 10,000 amps. at a pressure of 10–30 volts). Stuffing boxes are fitted to each bearing and means are provided for feeding oil in a thin film onto the heated rotating inner cylinder. Distillation or cracking, occurs and the vapours produced are drawn off through a valve, so that if desired, the whole operation can be carried out under pressure. Scrapers fitted underneath the rotating cylinder, cause any deposit formed to fall into the outer cylinder where it can be removed periodically through handholes. S. F. B.

418. Continuous Refluxing Still. M. J. Trumble. U.S.P. 1,586,133. 25.5.26. Appl. 8.9.24.

Vapours from a cracking still are passed *via* a pressure regulating valve to a water-cooled condenser, in which part remains uncondensed (this is taken off and collected separately) and part is condensed. The condensate is delivered to a closed re-run chamber where it becomes partly re-vaporised by contact with a closed worm through which vapour straight from the still is circulated (this being returned to the still as liquid). The unvaporised portion is returned by a pump to the still ; the vaporised portion is taken to a condenser in which part is condensed and collected, whilst part is removed as vapour and dealt with elsewhere.

W. S. N.

419. Systematic Refining of Cracked Distillates. J. C. Morrell. *Ind. Eng. Chem.*, 1926, **18**, 733–738.

The development of cracking in the oil industry has advanced so rapidly that to-day it is the greatest single factor in motor fuel production. It is probable that in the near future the largest proportion of the motor fuel produced will be cracked and that as the supply of petroleum becomes less plentiful, cracking stocks will be derived from shale oils, low-temperature coal tars, lignite, wood tars, etc. For the production of spirits from each of these substances it will be necessary to evolve a method of practical refining, in order to do which the chemistry of each type of cracked product must be recognised. The refining of cracked distillates is a much more complex problem than that of straight run distillates and deterioration occurs much more rapidly in the finished products. At present the commercial criteria for a refined motor fuel are absence of colour, sweet odour and stability under market conditions. The last refers to the development of colour, cloud or odour during handling or storage. Other tests are sometimes applied but although these are occasionally based on the treatment the fuel is likely to receive in use, these tests should be further investigated to put this relationship upon a more national basis. For example, although the sulphur content of a fuel is often required, it has not yet been shown how the sulphur does affect the internal combustion engine. Similarly the gum test is not necessarily a measure of the gummy substances already present in the gasoline,

but is rather a measure of the gums produced by the arbitrary method of determining them. In general, four methods are used for the refining of cracked distillates, the actual method employed being determined by the distillate to be treated.

(1) This method is applicable to easily refined distillates :—
(a) Treatment with sulphuric acid 66° Bé. and removal of sludge.
(b) Water wash.
(c) Treatment with sodium hydroxide solution followed by a small water wash, and finally
(d) Distillation in presence of steam.

(2) This is the most widely used method. It is similar to the first excepting that the soda wash is replaced by agitation with sodium plumbite solution. It may also be necessary to employ a small soda wash after distillation if the distillate is at all sour.

(3) This method is especially suited to cracked distillates from light or heavy Californian, Mexican, South American or similar oils.
(a) A preliminary water wash is given and followed by treatment with plumbite solution. The sludge is then drawn and another short water wash given.
(b) Agitation with a small amount of sulphuric acid (about 1lb. per barrel) for five minutes and removal of sludge.
(c) The main sulphuric acid treatment is applied and after the sludge has been drained, another water wash is given.
(d) Further treatment with plumbite which may be replaced by soda if the distillate is already "sweet."
(e) Distillation as in method (1) the distillate being soda washed if necessary.

(4) Methods (1), (2) and (3) all give water-white sweet products which are practically non-corrosive if proper attention has been paid to the redistillation of the distillate. The fourth method is not to be recommended and is only employed when the others fail. It consists in the addition of a small amount of elementary sulphur, about 0·01 per cent. of the weight of the oil, to the distillate before the treatment, which is then carried out as in method (3). The addition of free sulphur at this stage is least harmful and is best added already dissolved in some of the untreated distillate. Gasoline distillates from certain types of treated cracked distillates may be treated with plumbite directly, using a small and carefully regulated amount of sulphur and the products obtained, particularly if blended with straight-run gasoline, may be reasonably stable.

Such treatment is not to be recommended, for these products can equally well be handled by one of the previously described methods and the possibility of traces of elementary sulphur finding their way into the gasoline is thereby eliminated. It is essential that the finished products should be free from elementary sulphur, not only on account of its corrosive action but also because it considerably lessens the stability of the gasoline itself and causes the formation of tarry coloured substances.

Acid Treatment.—The actual treatment must vary with the distillate to be refined. For the sulphuric acid agitation, acid having a gravity of 66 Bé, is usually employed as it is always available and is convenient. Weaker acid is sometimes used with slightly better results, particularly when the products are derived from sources other than petroleum. The amount of acid required varies considerably with the distillate treated but always falls within the limits of 2 to 8 pounds per barrel. Sludge from previous

treatment may be used if some fresh acid is added, but economies in this direction must be practised with caution. The acid treatment must never be applied to wet oils but must be preceeded by agitation with a small quantity of acid, preferably 1 lb. per barrel. The age of the distillate to be refined is an important factor, distillates which have been stored for several months requiring more acid than when fresh. At the same time, storage for short periods, *e.g.*, several weeks, facilitates treatment.

Plumbite Treatment.—For most cracked distillates from 0·02 to 0·2 lbs. of litharge per barrel is employed, but it may be necessary to use a heavier treatment if the distillate is rich in mercaptans. When the plumbite treatment is given previous to the acid, the best results are obtained by dissolving the litharge in sodium hydroxide solutions containing from 13·5–24 per cent. caustic soda: if the treatment is to follow the acid, weaker soda is used (4–11 per cent.). The litharge is actually dissolved in the sodium hydroxide solution while this is still hot, to give a saturated solution and on cooling, the excess separates out. Roughly 1·5 per cent. litharge dissolves in an 11 per cent. solution of the hydroxide while the 24 per cent. dissolves 3 per cent. The average distillates require from 1–2 per cent. volume of solutions prepared in this way.

Water Washes.—These are generally desirable preceeding and following all chemical treatments of cracked distillates. An initial water wash tends to remove hydrogen sulphide and other water soluble impurities. Five or ten minutes' agitation with water is usually ample. Sodium hydroxide treatments are employed when it is necessary to neutralise acid products and the extent of such treatments is determined by the amount of acid to be neutralised. As even such mild reagents as dilute sodium hydroxide solutions may affect the colour of the gasoline, it is important to keep the concentration of soda as low as possible. Thus solutions containing 0·5 per cent. sodium hydroxide and less will improve the odour without affecting the colour. The tendency for mercaptans to be formed during the final steam distillation can be corrected by increasing the steam used; the gasoline is then generally rendered quite sweet by a small soda wash. Certain types of distillates, *e.g.*, those produced in plants which allow film super-heating of the cracked distillate, become decolorised or clouded, especially on short exposure to direct sunlight. This can generally be remedied by treatment with fuller's earth, an adsorptive earth or clay. The distillate is either allowed to flow through a column of coarse or granulated earth or preferably agitated with the reagent in a finely divided form. Removal of the earth from the gasoline if the latter method is employed, is accomplished by adding water and, after slight agitation, drawing off the earth with the water. The mechanism of this reaction is doubtful but it is probable that polymerisation of the colour-forming substances occurs with subsequent adsorption. Gasoline treated with adsorptive earths always show a high gum test. The treatment of cracked distillates from sources other than petroleum is very similar to the method already described. Cracked distillates from shale oils generally require complete steam distillation, and a final treatment with clay is usually necessary to render them stable. Low temperature tar distillates are given a preliminary soda wash to remove phenols: bases are removed during the acid treatment. Agitation with dilute sulphuric acid (60–90 per cent.) may sometimes be advantageously substituted or combined with the usual acid treatment when refining these distillates.

Treating Equipment.—All these principles can be applied to either batch or continuous treatment of the cracked distillate and use can be made of the usual types of plant. Between treatments it is advisable to discharge

the oil into a reservoir tank so that it can be mixed in the correct proportion with the next reagent. Distillation must be carried out reasonably rapidly as chemical changes may occur on prolonged heating which render the gasoline sour and unstable. Increasing the steam tends to produce a better product, but also increases the cost and decreases the capacity of the still. Diagrams of plant employed for batch and continuous treatments of cracked distillates are given. S. F. B.

420. Process for Renovating and Clarifying used Gasoline. William Allinson. U.S.P. 1,585,456.

Dirty gasoline may be purified by passing it, preferably under pressure, into the lower part of a refining solution having a gravity greater than that of the gasoline, in such a manner that after thorough mixing has taken place, the gasoline rises to the surface, leaving the impurities behind. S. F. B.

421. Treatment and Refining of Mineral Oils. J. J. Allinson, Assr. to Doherty Research Co. U.S.P. 1,592,324 of July 13. Appl. of May 4, 1920.

Crude petroleum containing natural brines is confined and heated in a rapidly moving stream by heat interchange with hot oil residuum. Brine is then separated from the oil. The oil then is heated a second time by heat interchange with residuum, is expanded, and vapour, additional brine and residuum separated therefrom. The apparatus comprises a connected series of heaters, a settling tank between successive heaters, a vapour tower connected to the last heater, a connected series of oil stills, and a salt and water separator between the vapour tower and the oil stills. H. M.

422. Gasoline Recovery Apparatus. H. B. Bernard, Assr. to Sinclair Oil and Gas Co. U.S.P. 1,584,504 of May 11. Appl. of June 20, 1924.

Absorbed constituents are separated from liquid absorbents in an exhausting tower with means for promoting gas and liquid contact and heat exchange. A partition in the lower part of the tower divides it into a heated supply compartment, into which charged liquid absorbent is introduced, and a discharge compartment opening upward into the tower. Liquid may be withdrawn from the supply compartment and discharged into the tower over the upper part of the contact-promoting devices, and from the lower part of these conducted to the discharge compartment. Gases and vapours may be withdrawn from the upper end of the tower, and liquid from the discharge compartment. H. M.

423. Extracting Vapours from Gaseous Mixtures. G. A. Burrell, G. G. Oberfell, and C. L. Voress, Assrs. to Gasoline Recovery Corp. U.S.P. 1,595,683 of August 10. Appl. of June 18, 1920.

The vapours of mineral oils of varying boiling limits over a range of 10° F. or more are recovered by contacting the mixture with particles of activated carbon. A portion of the vapours is absorbed a fraction of a second after such contact, and then more of the gaseous mixture is passed, so that lower boiling vapours are revolatilised and higher boiling vapours absorbed until such vapours as it is desired to recover are held and lower boiling vapours excluded. A volatilising agent is then introduced into the charcoal for distilling the vapours. The condensed portion of the vapours is separated from the volatilising agent by gravity, and the second portion of the vapours subsequently condensed by cooling and/or pressure. H. M.

424. Mixing Apparatus for Treating Hydrocarbon Oil. H. J. Broderson and W. E. Bartels, Assrs. to Standard Oil Co. U.S.P. 1,594,041. Appl. of March 24, 1924.

In order to treat an oil with a small quantity of immiscible reagent an atomising device is introduced into the pipe conveying the oil whereby the reagent is sprayed along the surface of a small cone whose apex points up the current of oil and whose axis coincides with the axis of the pipe. Orifice mixers further complete the mixing. W. N. H.

425. Process of Treating Hydrocarbons. J. R. McConnell. U.S.P. 1,590,841 of June 29, 1926.

Motor spirit (not treated with acid or clay) from certain types of crude possesses the objectionable property of becoming highly discoloured when exposed to daylight. The invention describes a method whereby this deterioration can be eliminated without the use of acid or clay. The spirit is placed in a tank or other vessel fitted with windows in the roof, whereby sunlight is allowed to act on the spirit and "fix" the unstable colouring compounds. The colour fixation may also be accomplished by the use of an artificial light such as the ultra-violet ray. Distillation of the sunlight-treated spirit will then produce a material which will remain water white when exposed to daylight. W. H. T.

426. Production of Aromatic Hydrocarbons. A. E. Dunstan, R. Pitkethly, and E. S. L. Beale. E.P. 250,701 of January 29, 1925.

The utilisation of the extract produced in the treatment of kerosene and heavier oils with liquid sulphur dioxide is proposed. This extract, which consists chiefly of the higher aromatic hydrocarbons, is freed from sulphur dioxide and subjected to cracking conditions at a temperature of 420–440° C. and a pressure of 400–1000 lb. per sq. in. Under these conditions an extract which originally showed 1 per cent. yielded 36 per cent. boiling below 200° C., the distillate consisting chiefly of benzene, toluene and xylene. S. B.

427. Petroleum Sludge, Continuous Separation of. J. Hechenbleikner and T. C. Oliver. U.S.P. 1,586,801.

Acid sludge is subjected to the action of steam under pressure greater than atmospheric to obtain a chemical separation of the hydrocarbon and acid components. The components are withdrawn from the sludge as a mechanical mixture and a physical separation effected. G. S.

428. Purifying and Decolourising Agent for Oils and Method of Making the Same. Harold L. Kaufmann. U.S.P. 1,579,326 of April 6, 1926.

The mineral leverierrite (aluminium silicate) as obtained from the ground is pulverised so that 95 per cent. passes through a 200-mesh sieve, is treated with a 20 per cent. solution of sulphuric (or other acid) at about 200° F. for from 6 to 8 hours. The material is washed with water and is allowed to settle out, the latter process being hastened if necessary by the addition of alcohol or other ingredient which hastens settling. To prevent oxidation and loss of activity the leverierrite may have oil, of a similar nature to that which will subsequently need to be decolourised, added to it. The leverierrite may also be dried at about 230° F. before use. A. W. G.

429. Treating Hydrocarbon Gases. J. E. Kobomik, Assr. to Newton Process Manufacturing Co. U.S.P. 1,594,014. Application of October 27, 1925.

Lean gases are compressed to about 500 lb. per sq. in. and preheated to 300° F.; they are brought into intimate contact in a tower with absorbing oil, kerosene heated to 300° F. The enriched gas and the lean oil are separately cooled and are again brought into intimate contact at 50° F. to 90° F. The enriched oil resulting is topped to give a stabilised distillate, and the residue is passed to the hot mixing tower again. Seven pints of motor spirit per 1000 cub. ft. of lean gas are stated to have been obtained.
W. N. H.

430. Gases, Removal of Hydrogen Sulphide and other Noxious Constituents. The Koppers Co. E.P. 255,144.

A process and apparatus is claimed for the purification of gases by the removal of hydrogen sulphide and other acidic gases from gases lacking ammonia. The gas is washed with a dilute alkaline solution, which is revivified by heating or aeration, and a metallic chloride is added to the wash to form hydrochloric acid in the revivifying stage and so assist the removal of acidic gases.
G. S.

431. Improvements relating to the Treatment of Petroleum Oils. E. C. R. Marks, comm. by Solar Refining Co. E.P. 254,784 of April 3, 1925.

Skimmed petroleum, deprived of its content of gasoline and kerosene, or some crude petroleum oils, are treated with alcohol, preferably anhydrous, in a series of extraction tanks provided with baffle plates, at a temperature of 150° to 175° F. It is proposed to make use of four extraction units, and in starting operations a batch of oil is treated in the first unit till the alcohol has extracted the light portion or cracking stock, when it is passed to the second unit, in which the light lubricating components are extracted by alcohol, and thence to the third unit, in which lubricating oil of 250–310 seconds viscosity Saybolt is extracted. In the fourth unit heavy lubricating oil of 450–500 seconds viscosity Saybolt is extracted, and the residue is an asphalt very free from free carbon and of excellent binding qualities, flowing slowly at 100° F. The alcohol with its content of extracted oil is settled and then run into a still where the alcohol distils off and is recovered in a water condenser and dehydrated by treating with quicklime and with anhydrous copper sulphate. It is then passed to a storage tank in which bags of anhydrous copper sulphate are suspended, and is continuously re-used for extraction. The oil remaining in the alcohol stills is drawn off and dried to remove traces of alcohol, except in the case of cracking stock. The red lubricating oils produced require further to be steamed once and colour-treated. The fraction from the third unit may undergo additional extraction in a supplementary unit to remove the less viscous constituents. After operations have been commenced the process is continuous, its speed being regulated by the rate of distillation in the alcohol stills. The only heat required is supplied by steam coils, and exhaust steam may be employed. Cracking is entirely avoided in the operation and great economy of heat is effected. The fractions of oil separated in the successive extraction units are approximately 35 per cent., 10 per cent., 35 per cent., and 10 per cent., leaving 10 per cent. of residuum. The proportions of alcohol required for the oil to be extracted amount, in the first unit to 1½ to twice the amount, in the second 2 to 4 times the amount, in the third 3 to 5 times, and in the fourth 4 to 6 times the

amount. When a paraffin base oil is used as raw material the lubricants have to be cold-pressed to remove wax. The presence of a trace of alcohol decreases the viscosity of these oils and favours chilling and cold-pressing, after which the alcohol may be removed. The lubricating fractions produced are very homogeneous and of superior quality, and about 2½ times greater in quantity than those obtained by overhead distillation from similar stock. H. M.

432. Treatment (Blowing) of Oils and Hydrocarbons. J. S. Miller, junr. U.S.P. 1,586,376. 1926. Appl. September 23, 1920.

Bituminous materials of mineral origin, *e.g.*, natural and artificial asphalts, petroleum oils and residuums, coal-tars, etc., are preheated and atomised with air into a heated converter. The violence of the reaction may be modified by diluting the air with carbon dioxide, producer gas, etc. The "blown" oil may be further treated in a series of converters to give products of progressively higher melting points. H. G. S.

433. Gas Mixtures, Recovery of Condensible Vapours. G. G. Oberfell and E. A. Burrell. U.S.P. 1,595,682.

The liquefiable constituents of a gas mixture are recovered by absorption with activated charcoal. The absorbed vapours are removed from the medium by heating the latter and passing another gas through the solid absorbent while heating under pressure, and then condensed. G. S.

434. Hydrocarbon Vapours, Recovery of. G. G. Oberfell. U.S.P. 1,595,681.

Natural gas is kept in contact with activated carbon until freed of its gasoline content. Fresh gas is supplied until the rate of absorption lessens materially. The gas is then cut off and the carbon distilled to drive off the gasoline in vapour form. The vapours are condensed and collected. G. S.

435. Apparatus for Treating Oil. N. W. Shefferman. U.S.P. 1,597,628 of August 24th, 1926.

A new type of apparatus is described in which oil may be treated with liquid and solid purifying agents. The liquid purifier is fed directly into the reaction vessel from a hopper. The solid is conveyed to the reaction vessel by a screw conveyor from a second hopper. The oil is removed from the reaction vessel by means of a pipe connected to a centrifuge. The apparatus is so arranged that the reaction vessel agitator, the screw conveyor, a crusher for the solid purifier and the centrifuge are all driven from a common driving shaft. K. B. R.

436. Process for the Thermal Decomposition of Gaseous Hydrocarbons, Natural Gas, etc., by Heat. I. Szarvasy. U.S.P. 1,592,474 of July 13th, Appl., February 23rd, 1924.

Useful products are manufactured by passing gaseous hydrocarbons into a chamber maintained at a decomposing temperature and provided with pervious walls. The chamber may be in part heated by gases passing through the walls and burning in proximity to them. H. M.

437. Purification of Petroleum. Gesellschaft für Warmetechnik and A. Ufer. E.P. 251,117 May 21st, 1925.

Treatment of petroleum spirit with sulphuric acid is followed by the addition of water or a salt solution before the waste acid is run off. The advantages gained thereby are a more complete separation of the acid from the refined spirit and also separation of resinous bodies from the acid. If ammonium

sulphate solution be used the acid liquor can be returned to an ammonia saturator and the separated resins mixed with crude tar for distillation. An economy in neutralising reagents is claimed by the more complete separation of the acid. S. B.

438. Removal of Sulphur and Sulphur Compounds from Hydrocarbon-Oil Distillates. Gerald N. Wendt. U.S.P. 1,594,083.

Distillate oils, containing products boiling within the gasoline-kerosene range, may be refined by treatment with doctor solution followed by distillation. The distillation is carried out under such conditions that the maximum temperature reached does not exceed 400° F. *i.e.*, the oil is distilled at atomspheric pressure until the temperature reaches 400° F. When the pressure is reduced to continue the distillation at that temperature. S. F. B.

439. Gasoline Production of (From Natural Gas). H. M. Weir, assr. to Standard Development Company. U.S.P. 1,594,915.

The gasoline is absorbed from the gas by a suitable absorbent and heated gas and superheated steam passed through the absorbent to drive off the gasoline in vapour form. The vapours are passed through an oil distillate containing gasoline and heavier constituents and the evolved vapours condensed and collected. G. S.

440. Improvements in or Relating to the Removal of Sulphuretted Hydrogen from Gas and Apparatus Therefor. Woodall-Duckham Ltd., E. W. Smith, and T. C. Finlayson. E.P. 245,575.

Spent liquor (*e.g.* sodium carbonate solution) used in the removal of hydrogen sulphide from gases is revivified by intimate contact with air in an arrangement of air-lifts. Liberated elemental sulphur is isolated. A. W. G.

441. Art of Refining Oils. R. Wiles. U.S.P. 1,579,799. Apr. 6, 1926.

A process of refining oils for the production of gasoline which comprises subjecting hydrocarbon gases containing gasoline constituents to the absorbent action of reduced crude oil, admixing the reduced crude oil with crude oil containing gasoline and heavier constituents, the said reduced crude forming 20 to 50 per cent. of the mixture, and fractionally distilling the mixture. A. W. G.

442. Oil Dehydrator and Cleanser. Luther I. Arnold. U.S.P. 1,597,337 of Aug. 24th, 1926.

A combined boiler and dehydrator obviates the necessity of a separate plant for steam generation. The smoke stack is used as a preheater. K. B. R.

443. Method of Dehydrating Crude Oil. R. J. Barry. U.S.P. 1,593,893. July 27th 1926.

The patent describes a means of dehydrating crude petroleum, or breaking down emulsions of crude petroleum and water, such as are found in oil wells. The mixture is placed in a convenient tank or other receptacle capable of being heated with steam coils. 1 per cent. by weight or less of common salt is added to the emulsion together with 0·1 per cent. of clay or similar material. When the emulsion will not break under this treatment, the mixture is heated until considerable frothing occurs, the temperature attained being about 204° F. The brine and clay may be employed again in the treatment of the next batch of basic sediment. W. H. T.

444. Treating Mineral Oils. G. L. Fogler. U.S.P. 1,587,111.

The demulsification of a mineral oil emulsion is effected by establishing a moving stream of the emulsion, adding water to this, rotating the advancing mixture about its axis in a confined space, and allowing such mixture to separate by gravity. G. S.

445. Process for Treating Petroleum Emulsions. M. de Groote and E. H. Keiser. U.S.P. 1,595,457. Aug. 10, 1926.

The invention consists of a means whereby petroleum emulsions may be broken by treatment with an insoluble salt of an organic soap-forming material. W. H. T.

446. Process of Treating Petroleum Emulsions. M. de Groote and W. C. Adams. U.S.P. 1,595,456. Aug. 10, 1926.

A process is described in which petroleum emulsions are broken by the use of a protein condensation derivative. This derivative bears a simple genetic relationship to the parent material and contains an organic substance whose alkaline earth salt is insoluble. W. H. T.

447. Process for Treating Petroleum Emulsions. Melvin de Groote and W. C. Adams. U.S.P. 1,595,455. Aug. 10, 1926.

The invention relates to the treatment of emulsions of mineral oil and water for the purpose of separating the oil from the water. It is found that many carbohydrate derivatives can be used in the treatment of petroleum emulsions owing to the fact that they have the ability to be wetted by water, to adsorb strongly at inter-facial surfaces, and to form insoluble salts of the alkaline earths. It is proposed therefore to use a modified carbohydrate condensation derivate in which the carbohydrate group bears a simple genetic relationship to the parent material. The material condensed with the modified carbohydrate can be any substance, such as a fatty acid, resin, naphthenic acid, or an aromatic substance. The treating agent can be introduced into a producing well, into a pipe-line carrying petroleum emulsion, or into storage tanks containing this emulsion.

After treatment the emulsion is allowed to stand in a quiescent state at a suitable temperature in order to permit the water to separate from the oil. In addition, suitable emulsion-breaking apparatus may be used, such as a centrifugal or electrical dehydrator. W. H. T.

448. Process for Treating Petroleum Emulsions. Melvin de Groote. U.S.P. 1,590,617. June 26, 1926.

The invention relates to the treatment of emulsions of mineral oil and water, such as petroleum emulsions, for the purpose of separating the oil from the water. The emulsion is treated with water in which is suspended an insoluble alkaline-earth salt of a mineral sulphonated oil, W. H. T.

449. Process for Treating Petroleum Emulsions. Melvin de Groote. U.S.Ps. 1,596,597 and 1,596,598 of Aug. 17, 1926.

The acid sludge obtained in petroleum refining is thought to consist of a mixture of naphthenic acids, naphthene sulphonic acid and naphthenic sulphonic acids, which may be represented by the following formulae :— $C_nH_{2n-2}O_2$, $C_nH_{2n-1}HSO_3H$ and $C_nH_{2n-3}HSO_3{\cdot}O_3$. On treating this mixture with an aromatic hydrocarbon in the presence of sulphuric acid condensation takes place. The salts of the resulting acids act as emulsion "breakers." If the mixture of naphthenic and sulphonated naphthenic acid is esterfied, the resulting esters are also valuable as breakers for water in oil emulsions. K. B. R.

450. Process for Treating Water in Oil Emulsions. Melvin de Groote. U.S.Ps. 1,596,588 and 1,596,592 of Aug. 17, 1926.

These two inventions propose using the neutralised acid or alkali or neutral sludges obtained in the refining of shale oils. These sludges may be used in the form of neutral alkali salts which are soluble in water or may be converted into the insoluble salts of the alkaline earths or heavy metals before use. K. B. R.

451. Process for Treating Petroleum Emulsions. Melvin de Groote. U.S.P. 1,596,596 of Aug. 17, 1926.

Water in oil emulsions may be broken by using a salt or an ester of a polycyclic sulphonic acid or the acid itself. Such substances may be prepared by sulphonation of naphthaline, anthracene or naphthracene. The inventor suggests that the oil may be treated in storage tanks or by introducing the agent into a producing well. K. B. R.

452. Method of Dehydrating Oil Emulsions. R. A. Halloran. U.S.P. 1,597,461 of Aug. 24, 1926.

Sludges obtained by treating petroleum with sulphuric acid may be classed as polymerised sludges and sulphonated sludges. The former are obtained by the action of dilute sulphuric acid on unrefined petroleum, while the latter are obtained when concentrated acid is used. The sulphonated sludges act as effective emulsion breakers. It is found that the best conditions result when the emulsion is heated to 175° F. before treating with the sludge. The treated emulsion is then agitated for one to two hours. The emulsion is then allowed to stand for 8 to 24 hours, when the water should settle out. It has been found that the sludge obtained in kerosene refining is most suitable as an emulsion "breaker." K. B. R.

453. Breaking of Oil-Water Emulsions. J. C. Walker. U.S.P. 1,597,700 of Aug. 31, 1926.

This invention deals with the treatment of oil-water emulsions with gaseous formaldehyde. A form of apparatus is suggested in which steam mixed with gaseous formaldehyde is passed into the oil. Formaldehyde is obtained by blowing steam through a solution of formalin. K. B. R.

Lubricating Oil and Wax.

454. Lubricating Value as Related to Certain Physical and Chemical Properties of Oils. L. W. Parsons and G. R. Taylor. *Ind. Eng., Chem.* **18**, 493–496.

Efficient lubrication is dependent upon two main factors:—

(1) Proper design and construction of bearing and bearing surfaces and
(2) an adequate supply of the correct lubricant.

The authors have dealt with the second of these factors in their paper. Under critical conditions of lubrication the oiliness proves itself of greatest importance and it is essential that the correct lubricant be employed having the necessary amount of oiliness. Various methods have been devised for measuring oiliness but the two most practicable proposed are the static friction test of Wilson and Barnard and the Deeley friction test. Although these are useful, the conditions under which the oil will be used must be considered, for oxidation products, which may be only partly soluble in the oil, may be formed and give rise to sludge—which clogs oil lines and so tends to prevent the oil reaching its destination. Acid products are also formed

and have a corrosive action on the metal surfaces. Thus for certain classes of lubrication, oiliness becomes of secondary importance, the actual behaviour of the oil itself coming first. This is particularly true of steam turbine lubrication. It can therefore be seen that the selection of the best lubricant for any special purpose cannot always be made on the basis of the common physical and chemical tests. After consideration of the necessary properties of the various oils the authors conclude that the following points must be remembered in selecting a lubricant:—

(1) An oxidation and emulsification test must be applied to oils for turbine work in addition to the usual physical tests in order that some idea of the behaviour of the oil under working conditions may be obtained.
(2) No satisfactory test other than actual service exists for determining the relative lubricating values of cutting oils.
(3) An oil intended for Ford transmission should possess a high degree of oiliness owing to the conditions under which it must operate.
(4) In developing the best grades of motor oils the oxidation test is of great importance and the emulsification test only of secondary importance.
(5) Motor oils to be used at low temperatures should be tested for their relative rates of flow under pressure at low temperatures, as the A.S.T.M. pour points test leads to erroneous conclusions.
(6) Gear oils and greases for use in automobiles can be tested for their relative value as lubricants in cold weather by the Bingham plastometer.

S. F. B.

455. Some little understood Factors affecting Lubrication. *Ind. Eng. Chem.*, 1926, **18**, 467–470.

Experiments have been carried out in order to examine the effect of various conditions on the lubricating properties of an oil. One apparatus employed consisted of a bowl of shafting steel, capable of rotation round a stationary metal ring, held by a calibated spring in such a manner that, as the bowl revolved, the ring tended to move against the spring. Torque reaction in the ring was thus balanced by the spring and could be measured by the position of a pointer on a graduated scale. The clearance between the metal ring and the bowl was approximately 0·033 cm., thus determining the thickness of the oil film. Increases in temperature were measured by a thin wire thermocouple projecting through the ring into the oil film. The results obtained showed that changes in friction cannot always be explained by changes in viscosity in the oil, due to temperature changes, and that other factors must be considered. Thus the metals employed for the bearing surfaces influence the friction considerably. This was readily demonstrated in the above apparatus by changing the metal ring by another of a different metal. Copper was found to give a lower friction curve than bronze, although the latter contained over 80 per cent. of copper. Experiments made with a complete bearing running in an enclosed vessel, so that the atmosphere surrounding the bearing could be altered, showed that the atmosphere used was a very important factor. The friction was always found to be lowest when an oxidising atmosphere surrounded the bearing; the friction increasing as this was removed or replaced by hydrogen. The authors therefore conclude that for efficient lubrication some kind of reaction is necessary which is dependent upon the presence of oxygen and moisture. A close study of the friction curves obtained shows that they all tend to come together in the neighbourhood of 100° C. The significance of this is not yet understood.

S. F. B.

456. Principles Underlying the Use of Equilibrium Oils for Automotive Engines. Robert E. Wilson and Robert E. Wilkin. *Ind. Eng. Chem.*, 1926, **18**, 486-490.

The dilution of crank-case oils by the heavy ends of gasoline is one of the outstanding problems of the present day in the lubrication of the automobile engine. It is well known that the two factors of most importance in producing dilution are cold starting with a choke and excessively cold cooling water, which causes the heavy ends of the gasoline to condense in the cold oil film on the cylinder walls and wash down into the crank-case. Acting in the opposite direction are certain factors tending to eliminate this diluent from the oil: and again the cooling water temperature is important, for when it reaches the proper operating temperature, *e.g.*, 160° F., the diluent is fairly rapidly eliminated from the oil on the cylinder walls. The temperature of the crank-case itself is important also, especially if there is much "breathing" of air into and out of the crank-case as in most four cylinder cars.

Theoretically the rate of elimination must be approximately in direct proportion to the diluent present, for the greater the amount present the greater the vapour pressure and therefore the greater the rate of elimination. This being so, it follows on theoretical grounds that the observed dilution should increase at first rapidly and then more slowly as the rate of dilution and elimination approach each other.

Eventually a point of equilibrium should be reached between the two, and then the amount of diluent present should remain substantially the same under uniform conditions of operation.

Experimental data obtained from road tests and dynamometer trials, have shown that this actually occurs, the crank-case oil losing about two-thirds of its viscosity in the first 150 miles of winter service, and from then onwards remains practically unchanged.

In view of this it is obvious that, if one should start with an oil containing that amount of diluent which represents equilibrium for any given car, the viscosity should remain almost constant in service and that, if the original oil forming the basis of the equilibrium oil is heavy enough, it should be possible to have an oil which is constant in viscosity over its entire period of service, instead of starting with an oil which is too heavy and ending with one which is too light as is usual at present.

To make an equilibrium oil which will give satisfactory starting and cold lubrication and yet have sufficient viscosity at all times in the average case, it is suggested that a heavy oil of from 425 to 525 secs. viscosity at 100° F. be blended with from 10 to 12 per cent. of a distillate, which has a boiling range roughly identical with that of the diluent found in the average crank-case as dilution.

The diluent itself does not appear to vary much from one car to another or from one that dilutes slightly to one that dilutes badly, it appears to be a rather close cut, practically all boiling between 275° F. and 450° F., with roughly 50 per cent. boiling below 350° F. Equilibrium oils prepared in this way, generally have an initial viscosity of 200 secs. and approximately maintain this throughout their useful life. Results of extensive tests made with this are given and seem to be very satisfactory. S. F. B.

457. Lubrication Data from Co-operative Fuel Research. S. W. Sparrow and J. O. Eisinger. *Ind. Eng. Chem.*, 1926, **18**, 482-485.

It is well known that oils become more viscous in use, chiefly through oxidation, but in an automotive engine owing to such factors as crank-case dilution, it is difficult to find what changes have actually occurred during service.

It is therefore necessary before any examination of a used oil can be made to determine the extent to which dilution has taken place. Two methods are available.

The first consists of a vacuum distillation and gives results accurate to 0·5 c.c., while the second, the capillary funnel method, is rougher, less accurate and consists essentially of a distillation at atmospheric pressure: the results obtained by this method are accurate only to 2·0 c.c. To find the influence of various factors on the crank-case dilution, experiments were carried out with a four-cylinder truck engine fitted with the usual laboratory equipment, under varying conditions and the dilution determined. It was found that when the oil is used over a prolonged period, a point is eventually reached when the dilution occurring is equalled by the concentrating action of the heat developed and that at this stage the oil is really unfit for further use. On the balancing effects of these two processes are based the so-called "equilibrium oils." Another important factor influencing dilution is the volatility of the fuel employed, for the dilution rapidly increases as this decreases. The temperature of the water-jacket, and consequently of the cylinder walls, also determines to some extent the dilution occurring, the reason for this being that if the temperature of the cylinder walls is lower than the dew-point of the fuel-air mixture condensation, dilution takes place. The importance of this factor can best be realised when the time taken for an engine to warm up from cold is considered, particularly as then the mixture used is invariably rich and the engine cold. The influence of the load upon the engine is determined by the amount of fuel used, this generally varying directly with the load imposed.

Air-intake temperature and viscosity of the oil employed do not appear to affect the dilution, and the authors consider that the fit of the piston rings is a much over-rated factor.

Tests were also made to find the effect of the viscosity of the oil upon the breakaway torque when starting.

The chief function of the oil in an internal combustion engine is to reduce wear and friction by keeping the moving parts away from each other. Oils are therefore recommended for use which possess a good margin of viscosity above and below that likely to be required in the most extreme conditions encountered in any particular engine. Objection is generally raised to the use of heavier oils in cold weather as it is considered that they cause difficulty in starting. The results of the tests carried out indicate that in general the break away torque is not affected by changes in viscosity of the oil as, on rotating the engine, most of the oil is squeezed out and lubrication is determined by the oiliness of the oil alone.

This was confirmed by adding 5 per cent. of lard oil to the oil when a reduction of 25 per cent. occurred in the breakaway torque.

The authors consider that the corrosion of piston pins, tappets, etc., generally known as crank-case corrosion, is really due to the condensation of water. This is particularly likely to occur when the engine has been started up after a period of disuse and all the oil has drained out of the crank-case. S. F. B.

458. Surface Action and Fluid Film Lubrication. A. E. Becker. *Ind. and Eng. Chem.*, 1926, **18**, 471–477.

From a study of fluid film lubrication, the two following principles, which are fundamental, become obvious: (1) The lubricant must adhere to one or both of the bearing surfaces in order that the film may be produced; and (2) when the adhesive forces and the conditions of operation are such

as to permit fluid film lubrication, the thickness of the film formed is a function of the viscosity of the lubricant at the working temperature of the film.

When considering the first of these principles, an allowance must be made for any lubricant unable to adhere to all bearing surfaces to the same degree of tenacity, or even in such amounts that the adhesive forces are always greater than the cohesive forces within the lubricant. Theoretically, therefore, four bearings can exist in which the lubricant adheres to both, to one, to the other or to neither of the two bearing surfaces. To distinguish between these, it is necessary to determine the magnitude of the adhesive forces between the lubricant and the bearing metal. Since no satisfactory method has been devised for making such measurements, the author has designed an apparatus capable of doing so. The action of this apparatus is dependent upon the fact that two bearing surfaces, separated by an oil film, constitute an electrical condenser in which the oil forms the dielectric. The apparatus consists of two removal elements, made from any desired materials, which form the bearing surfaces. The lower or stationary element is set in a cup of insulating material (*e.g.*, bakelite), this also acting as a receptacle for the oil under test.

The upper or rotating element is mounted on the end of a vertical shaft of very light construction, and so designed that it can be rotated at any desired speed.

A special device enables pressures to be applied through the shaft to the bearing. Electrical contacts are taken from the two elements, the upper contact being through a bowl of mercury situated on the upper end of the shaft. With this apparatus it is possible by means of a Wheatstone bridge arrangement to determine the capacity of the condenser formed by the bearing, and from this the thickness of the oil film itself. The curves obtained by means of this apparatus, using different oils, show that the thickness of an oil film developed in a given bearing using a given oil and at a definite oil temperature—*i.e.*, constant viscosity—is a logarithmic function of the speed and load. The film thickness can actually be represented in terms of load, speed and viscosity by the general equation:

$$t = K\left(\frac{1-\log_e P}{A}\right)\left(\frac{1-\log_e S}{B}\right)\left(\frac{1-\log_e \mu}{C}\right)$$

where K, A, B and C are constants depending upon surface action forces. From this equation the author has calculated the thickness of various oil films and has found that these thicknesses agree very closely with the observed values. S. F. B.

459. The Role of Graphite in Lubrication. F. L. Koethen. *Ind. and Eng. Chem.*, 1926, **18**, 497–499.

Lubrication consists of two separate problems: (1) Where conditions are such as to permit perfect fluid films to support the load, viscosity then being the controlling factor; and (2) where the fluid film has broken and actual rubbing contact takes place, lubrication then being dependent solely upon the substances adsorbed on the metallic surfaces. Viscosity is then of little importance.

In the paper, tests carried out on a Riehle machine to determine the amount of pressure required to rupture the fluid film in a 3-inch bearing rotating at constant speed, using oil with and without suspended graphite, are described. The results obtained indicate that while running on plain oil, the figures found closely approximate those for the internal friction of the

oil, but that after a graphite film has been deposited on the surfaces of the bearing, although the oil still determined the lower limit for the friction, the pressure on the bearing could be increased to 180 per cent. of its original value before the film commenced to break. Determinations of friction, with and without graphite, made with a friction slider, also indicated that graphite is effective in prolonging the period of unbroken film lubrication and, in the ruptured film stage, reduces friction and minimises metallic contact. A possible explanation of its action is that it is deposited in the low spots giving a smoother surface, and at the same time that when solid-to-solid contact does occur, it abrades more readily and with less friction, and consequently less damage, than the plain metallic surfaces do alone.

S. F. B.

460. Comparison of Lubricating Efficiencies of Oils and Some of their Physical and Chemical Properties. M. U. Dover. *Ind. and Eng. Chem.*, 1926, **18**, 499–501.

The author has compared the following properties of three mineral oils and one vegetable oil—olive oil: iodine number, acid number, flash point, specific gravity, viscosity, surface tension, interfacial tension and efficiency as lubricants.

A short account is also given of some experiments, suggested by the work of Wilson and Barnard (*J. Soc. Automotive Eng.*, 1922, **11**, 150), on the clogging effect of iron or steel capillaries by two of these oils.

S. F. B.

461. The General Properties of Lubricating Oils and their Practical Application. A. E. Dunstan and R. W. L. Clarke. J.S.C.I., Vol. 45, No. 39, pp. 690–694.

Lubricating oils may be divided into two classes, *viz.*, animal and vegetable oils, and petroleum oils. This paper deals with the latter class, which consists of mixtures of hydrocarbons having formulae varying from C_nH_{2n} to C_nH_{2n-4}. Mabery has found the components of the products from American crude oils to vary from 304 to 1700. Distillation of crude oil yields petrol, kerosene, gas oil and a residue. Steam or vacuum distillation of this residue gives lubricating oils. After distillation the oils are treated for the removal of wax. Several methods depending on the separation of the wax on chilling are in operation. The oil is now refined by treatment with sulphuric acid following by alkali and water or clay. Refining is carried out in order to remove unsaturated substances which would cause gumming in bearings and deposition of carbon in internal combustion engines. Lubricating oils are classified by appearance and physical or chemical properties thus: dark, red, low setting point and neutral oils. The physical and chemical properties of lubricating oils are valuable indications of the suitability of the oils for various uses. The pour point determines the temperature at which the oil can be used. Viscosity of oils are important. The acidity, saponification value, tendency to sludge may be given as some of the more important chemical properties which determine the usefulness of a lubricating oil. Results are given on the "heat of wetting" of oils. This property has been measured by stirring copper powder into the oil and measuring the rise in temperature.

K. B. R.

462. Process for Purifying Mineral Oils. J. F. Faber, H. C. Hanna and M. L. Chappell. U.S.P. 1,562,156.

Petroleum oils, such as lubricating oils, may be refined by treatment with sulphuric acid, separation of the acid sludge in the usual manner and

neutralisation of the treated oil by caustic soda solution containing metallic salts of petroleum carboxylic acids. The salts of the petroleum carboxylic acids are obtained free from sulphonated soaps by extraction of crude petroleum with aqueous solutions of metallic bases. It is claimed that in this method of refining mineral oils, the persistent emulsions generally produced on neutralisation of acid-treated oils with caustic soda are not formed. S. F. B.

463. Method of Using Concentrated Decolourising Clays for Refining Lubricating Oils. A. Jurrissen. U.S.P. 1,585,922. May 25, 1926.

The invention consists of a means of refining lubricating oils without the use of aqueous alkaline solutions. The oil to be treated is first agitated with concentrated sulphuric acid, and the acid sludge formed during the treatment subsequently removed. The oil is then removed to another mixing tank, and a quantity of finely divided clay blown in. The mixture is agitated, and towards the end of the period of mixing, dried slaked lime ($Ca(OH)_2$) is blown into the washer. The function of the lime is to complete the neutralisation of acid present in the lubricating oil. The clay and lime are subsequently removed by means of a filter press. W. H. T.

Cracking.

464. The Topping and Cracking of Panhandle Crude Oil. G. Egloff and J. C. Morrell. *Petr. Times*, 14., 203.

Panhandle crude is peculiar in that it has a high gasoline content and yet congeals at 50° F. The difficulty in handling it, in cold weather particularly, may be eliminated by cracking in the field. The topping and cracking of the crude oil would yield 70 per cent. or more gasoline, as panhandle crude with its high wax content lends itself particularly to cracking by the Dubbs' process, 25 cracking units would handle the total production of 50,000 barrels.

On a non-residual basis cracking of the topped crude showed a yield of 65 per cent. gasoline, and when operating to produce navy fuel the yield of gasoline was 55 per cent. The crude oil had sp. gr. ·840 and cold test 50° F. and contained gasoline 26·5 per cent.—sp. gr. ·742, I.B.P. 59° C., E.P. 218° C.; kerosene 16 per cent.—sp. gr. ·815, Fl. Pt. 156° F.; and fuel oil sp. gr. ·889—Fl. Pt. 328° F.

The crude oil was charged direct and cracked at 135 lb. pressure, and one test yielded 88·3 per cent. of distillate, composed of the natural gasoline contained in the crude plus the cracked pressure distillate. Redistillation of this product produced 70 per cent. navy gasoline, 14·2 per cent. of gas oil, and the balance coke, gas and loss.

Another run made on the same crude showed a yield of 62·3 per cent. navy gasoline and 15·8 per cent. fuel oil residue.

The crude oil contained 1.37 per cent. water holding chlorides of calcium, magnesium and sodium in solution, and ammonia may be injected into the cracking apparatus to counteract the corrosive action of the hydrochloric acid formed at the high temperatures used. R. P.

465. Direct Production of End-Boiling Point Petrol from Heavy Oils. G. Egloff and V. Henny. *Petroleum*, 1926, 22, 606–609.

It is desirable to market cracked petrol as far as possible in the state in which it leaves the cracking plant, to avoid polymerisation in further processes and the loss of the important antidetonating hydrocarbons. The "no residue process," which yields 53 to 78 per cent. of petrol, is compared with

the residue process. The production of a Dubbs' plant, in which the residue was continuously withdrawn from the reaction chamber, operating on Kevin-Sunburst fuel oil, amounted to 50 per cent. to 61 per cent. of the raw material, and on another plant operating on Kentucky fuel oil, 58 per cent. to 61 per cent. Details are given of the results with one passage of the raw material. As Californian oils contain much nitrogen and sulphur containing compounds the cracked distillates often contain 1 per cent. of sulphur, more difficult to remove than that in petrols from Mid-Continental oils. The oil of the Smackover field is difficult to refine, but produces 48·9 per cent. to 52·1 per cent. of a petrol of good antidetonating qualities. By the "no residue" method no residual oil is withdrawn from the reaction chamber during cracking, and the use of coke retorts is unnecessary. The method of simultaneous cracking and coke production requires but a slight alteration in the conditions of working. Details are given of the production of navy end-point petrol in a Californian plant, with a yield of 58 per cent. to 66 per cent. H. M.

466. Apparatus for Conversion of Oils. J. H. Adams. U.S. Pat. 1,595,332.

The apparatus consists of a supply tank, a furnace, and a plurality of vertical tubes extending through the furnace. These tubes are heated intermediate their ends to a cracking temperature. A connection supplies oil to their lower ends below the heating zone and a vapour chamber is disposed above the heating zone. The upper ends of the converter tubes extend into the vapour chamber to form overflow pipes to assist in the liberation of vapours and maintain a predetermined oil level therein. A carbon and residue collecting chamber is connected to the bottom of the conversion tubes. Means are provided, for the circulation of the oil through the system, for the removal of the carbon and residue from the bottom chamber, and for the removal of vapours from the upper chamber.

The process is conducted under pressure above atmospheric. R. P.

467. Process for the Conversion of Oils. J. H. Adams. U.S.P. 1,585,355, 1926. (Appl. June 15, 1916, and June 28, 1923.)

An apparatus for the cracking of oils in the vapour phase consists essentially of a preheater, converter and separator, together with oil supply tank, condenser and pumps. In the pre-heater, the oil is heated, under super-atmospheric pressure, to substantially its boiling point and is then expanded into the converter, where cracking takes place. The product then enters the separator, from the top of which gas and vapours escape through a condenser while heavy residues are taken off from the bottom to be re-cycled if desired. The pressure is equalised in converter, separator and condenser but is less than that in preheater. R. P.

468. Process for Treating Carbon and Carbon Compounds under Heat and Pressure. F. Bergius. U.S.P. 1,592,772, 1926. (Appl. Aug. 30, 1921.)

In the process whereby carbon or hydrocarbons are submitted to heat treatment under high pressure, either in presence or absence of hydrogen, heating is effected by passing hot inert gases through the annular space between the two walls of the reaction vessel. The heating medium is maintained at a slightly higher pressure than that of the reactants and a pressure gauge is inserted to indicate the extent of the pressure difference. H. G. S.

469. Art of Treating Hydrocarbons and Oils. L. B. Cherry, Assr. to C. and C. Developing Co. U.S.P. 1,588,308 of June 8. (Appl. Nov. 11, 1919.)

Oils and the like are subjected to cracking temperature at a cathode while traversed by an ionising electric current flowing from an anode to the cathode. H. M.

470. Pyrogenesis of Petroleum. E. M. Clark. U.S.P. 1,578,802, Mar. 30, 1926.

Petroleum oils are subjected to pyrogenesis by heating a body of relatively heavy oil to a decomposition temperature, the evolved vapours being allowed to pass into contact with a separated body of oil maintained at a lower temperature, whereby condensation is effected. The oil displaced by condensate in the second body is fed to the first oil body and the pressure, which is above atmospheric, in the whole is regulated by releasing permanent gases formed, these gases being freed from condensable components and passed through a condenser refluxing into the second body. The temperature in the first digestor is 250° F. and that of the second 600° F. A. W. G.

471. Process for Continuously Distilling and Cracking Hydrocarbon Oils. J. W. Coast, jun. U.S.P. 1,585,233, 1926. (Appl., July 14, 1919.)

The oil to be distilled and cracked—*e.g.*, crude, gas or fuel oil—is heated under pressure in a horizontal cylindrical still, the vapours being taken through a dephlegmator and condensed at atmospheric pressure. The still is fitted at its lower portion with mechanically operated scrapers which continuously push the carbon deposited on the bottom of the still to one end, whence it is withdrawn, together with a certain amount of the residual heavy oil into a coke settling pot. The heavy residue which settles with the coke is drawn off at intervals, whilst the lighter constituents of the heavy tar pass into an expansion drum in which the pressure is reduced to atmospheric, thus bringing about distillation. The vapours evolved from the expansion drum then enter an exchanger, where they mix with the incoming cracking stock, whilst the residue from the expansion drum, before being taken to storage, is also used to pre-heat the stock. A vapour line from the expansion drum conveys distillate to unfinished gasoline storage. H. G. S.

472. Apparatus for Cracking Oil. L. B. Cuddy. U.S.P. 1,598,805, 1926. (Appl., Nov. 10, 1919.)

The apparatus consists essentially of a cylindrical still erected vertically in a furnace, which is so constructed that the hot products of combustion enter around the top of the still and leave by flues at the bottom. The still is fitted with scrapers, the carbon removed from the walls being caused to settle into the lower conical portion from which it is removed periodically. H. G. S.

473. Process for Treating Hydrocarbons. R. Cross. U.S.P. 1,587,491.

Petroleum oil is vaporised under substantial pressure and the vapours passed through a mixture of bentonite, diatomaceous earth, and a salt of a metal—*e.g.*, copper, having an affinity for the sulphur compounds of the oil. The mixture is maintained at a temperature above the dry point of the oil, and the vapours are subsequently condensed and collected. R. P.

474. Process for Cracking Oil. P. Danckwardt. U.S.P. 1,594,666, 1926. (Appl., Aug. 6, 1924.)

A number of cracking tubes are placed in a vertical position and connected in series by pipes leading from the bottom of one tube to the top of the next. Each tube is separately enclosed in another tube through which superheated steam is blown, the steam jackets being connected in series. The oil to be cracked is pumped through the tubes, together with hydrogen or other gases if desired, and in countercurrent to the steam so that the oil emerges from the last tube at a temperature not exceeding 800° F. (427° C.). The oil is maintained under a pressure of 400 to 1,000 lb. per sq. inch, and the steam at approximately one-half this pressure, so as to reduce the strain on the cracking tubes: the exhaust steam may be employed for other purposes. The cracked oil now enters a separator-receiver in which the pressure is substantially reduced, the heavy oils which condense being recycled; the receiver also serves as a feed tank for fresh cracking stock. The gas and uncondensed vapours are next led through a mass of molten sodium hydroxide in which nickel or other catalyst is suspended; or heated oxides or hydroxides of the alkali or alkali-earth metals impregnated with nickel, iron, copper, etc. The vapours are then condensed. The use of alkali, in conjunction with nickel, lengthens the life of the catalyst. H. G. S.

475. Process of Cracking Petroleum Oil. C. P. Dubbs, Assr. to Universal Oil Products Co. U.S.P. 1,592,560, July 13. (Appl., Nov. 27th, 1922.)

The charging oil is passed in a restricted stream through the part of a heating zone which is at the lowest temperature, and then united with the reflux condensate formed in the process. The mixture is passed in a restricted stream through the part of the heating zone, which is at the highest temperature, and thence to an enlarged reaction zone from which no unvapourised oil returns to the streams mentioned. The vapours from the enlarged zone are passed to a dephlegmator, where part is condensed to form the reflux condensate mentioned, while the vapours pass to a final condenser. Pressure above atmospheric is maintained on the oil. H. M.

476. Process for Cracking Hydrocarbon Oil. C. P. Dubbs, Assr. to Universal Oil Products Co. U.S.P. 1,594,093 of July 27th. (Appl. Oct. 21st, 1922.)

The oil is raised to conversion temperature in a heating zone and then collected in a vapourising zone, where vaporisation takes place under pressure. The vapours pass to a dephlegmating zone and are subjected to the refluxing action of the entering raw oil. The uncondensed vapours pass under reduced pressure to a series of fractionating zones, and the vapours from the last zone are condensed. Selected portions of condensate are returned from each fractionating zone to the preceding fractionating zone. H. M.

477. Manufacture of Light Hydrocarbons. L. Edeleanu. U.S.P. 1,586,357, 1926. (Appl. Jan. 20, 1925.)

Heavy oils are converted into light products by distilling them in contact with a "double compound" of aluminium chloride and hydrocarbons. This "double compound" or "brown oil" is prepared by adding anhydrous Al_2Cl_6 to a dry hydrocarbon distillate, which has previously been extracted with liquid sulphur dioxide or alcohols or refined by means of acid and alkali. The mineral oil to be converted, whether refined or not, is heated to, say, 200° C., and the "double compound" gradually added. Conversion into light products begins at once, and a large yield of gasoline is claimed—*e.g.*, 52 per cent. of navy gasoline from a Californian gas-oil. H. G. S.

478. Apparatus for Cracking Oil. G. Egloff and H. P. Benner. U.S.P 1,598,368, 1926. (Appl., March 23, 1921.)

In an apparatus for cracking oil, the stock, after passing through coils heated in a furnace, is delivered into an expansion chamber consisting of a large, elongated, horizontally disposed shell provided with a dephlegmator and with a number of valve-controlled residium draw-offs.

The process is conducted under pressure, and the release of heavy tarry matter from the bottom of the expansion chamber increases the length of a run by reducing the quantity of coke deposited in the plant.

H. G. S.

479. Apparatus for Treating Oil. G. Egloff and H. P. Benner. U.S.P. 1,595,179.

The apparatus consists of a stationary still superimposed above a rotary still within a furnace. The upper parts of these stills are heated by pairs of burners so that the temperatures can be regulated independently. The stills are connected by a transfer line. Vapours pass from the upper still through a dephlegmator to a condenser. Condensate from the dephlegmator is drawn off and returned into the cracking system. The apparatus may be operated in various ways. The lower still may be rotated continuously or intermittently. The fresh charging stock may be delivered into either still or both, and the reflux may be returned to either still or diverted elsewhere as desired. The temperature may be varied and the lower still heated at a higher or lower temperature than the upper still, and differential pressure may be maintained on the different parts of the apparatus. R. P.

480. Apparatus for Controlling the Supply of Steam and Oil to an Oil-Cracking Still.—C. J. Greenstreet. U.S.P. 1,585,381 of 1926. Appl. Dec. 27, 1919.

Considerable difficulty has been experienced in controlling the supply of steam to the Greenstreet cracking plant (*c.f.* U.S.P. 1,110,924 of 1914). This problem has been solved by interposing an outlet valve between the supply and still valves in the vapour line. In operating the plant, the still valve is closed, the outlet valve opened and the supply valve then adjusted until the correct amount of steam is escaping into the air. The outlet valve is then closed and the still valve opened. H. G. S.

481. Apparatus for Refining Oils.—W. T. Hancock and M. Boyle. U.S.P. 1,576,742.

The apparatus consists, essentially, of a still having longitudinal perforated tubes supported internally by end plates which are spaced from the ends of the still. Superheated steam at about 1,500 lb. pressure is passed into the end spaces, thence through the perforated tubes into the oil space. The steam supplies the heat required to crack the oil, which is preheated to about 425° C. before entering the still. R. P.

482. Art of Cracking Hydrocarbons.—E. C. Herthel. U.S.P. 1,592,489.

In this process oil is circulated from a bulk supply tank through a heater and back to the supply tank and is caused to undergo stratification, because of the baffle arrangement within the tank. The cracked vapours are mostly removed from the upper layers of the oil, and such eddying or turbulence as exists is largely confined to the upper layers above the baffles into which the return line from the heaters discharges.

The baffles are arranged to permit of free circulation of the unvaporised oil in a generally downward direction through the bulk supply tank to the

lower or quiescent layers, and a tar draw-off eliminates the heavier portions. A reflux tower is arranged above the supply tank and reflux oil is returned to the pressure still while the vapours escape to the condenser. Fresh charging stock is introduced through the reflux tower in direct contact with the vapours. Pressure may be reduced or regulated by a regulating valve between reflux tower and condenser. R. P.

483. Process of Cracking Hydrocarbons. E. C. Herthel, Assr. to Sinclair Refining Co. U.S.P. 1,598,136, 1926. Appl. July 12th, 1922.

In a process for the cracking of oil by distillation under pressure, the deposition of carbon and consequent interruption of the process are brought about by the increasing concentration and final separation of pitch. The length of a run can therefore be extended by carrying out distillation until the point of pitch deposition is nearly attained, thereafter withdrawing heavy materials from the bottom of the still and increasing the rate of feed so as to maintain a constant level of oil in the still. The incoming oil further assists in keeping the pitch in solution. H. G. S.

484. Improvements in or Relating to the Cracking of Hydrocarbons. Sinclair Refining Co., E. C. Herthel and H. L. Pelzer. E.P. 246,116 of 1925; cf. E.Ps. 232,178 and 241,866.

In the cracking of hydrocarbon oils by distillation under pressure, the rate of deposition of carbon may be reduced by circulating the charge of oil through a mass of metallic oxides deposited upon a bed of filtering material, the whole being contained in the still. A certain proportion of the heavy asphaltic-charged oil is also withdrawn from the bottom of the still.
H. G. S.

485. Process for Making Gasoline. R. C. Holmes, F. T. Manley and O. Behimer, Assrs. to the Texas Co. U.S.P. 1,585,496. May 18. Appl. Nov. 21, 1918.

Hydrocarbon oil is forced through a heated coil and drum, the vapours developing pressure till decomposition of the hydrocarbon begins. The heat applied to the drum is then reduced, whilst the drum is secured against substantial loss by radiation and evaporation. The necessary heat is continuously supplied to the drum by the stream of oil entering from the coil, which mingles with the hot condensate from the generated vapours.
H. M.

486. Apparatus for Cracking Oils. R. C. Holmes and F. T. Manley. U.S.P. 1,583,973.

The apparatus described consists of a battery of vertical stills of large capacity, arranged in series within the heating chamber and having their ends projecting above and below the heating space. Flues conducting the furnace gases run along both sides of the heating chamber, dampers regulate the amount of heat supplied to each still, and perforated partition walls are provided between each still. The stills are connected to each other by two large-sized tubes, set one above the other; the lower determines the oil level and the upper balances the pressure. A manifold connects the stills at the bottom to a residue tank through which the feed pipe passes, thus preheating the oil before entering the bottom of the first still.

In order to keep the sides of the stills free from carbon, a cleaning device, consisting of a rotating shaft, carrying a number of scrapers, is provided in each still. Oil-cooled sleeves and stuffing boxes on the shaft prevent leakage.

To cool and protect the stuffing boxes, which would otherwise be subjected to an excessively high temperature, a heavy lubricating oil is circulated through the sleeves.

Heat is applied to the stills below the oil level, and the temperature of the oil is practically uniform in all the stills, but while a certain amount of cracking takes place in the first still a greater proportion of oil is converted in the following stills. Consequently, the amount of carbon deposited in the first still is comparatively slight and increases as the oil progresses through the apparatus. Heat is therefore applied at the highest temperature and in the greatest amount to the first still. The evolved vapours are cooled under pressure and the heavy condensate returned to the first still for further treatment. R. P.

487. Converting Hydrocarbon Oils into Lower Boiling Products. F. A. Howard. U.S.P. 1,586,994.

In this process mercury vapour is used to heat the oil contained in a jacketed still to the temperature required to decompose the oil. R. P.

488. Process of Catalyzing Oils. G. L. Prichard and H. Henderson. U.S.P. 1,585,263.

A mixture of oil and aluminium chloride is passed through a coil immersed in a heated lead bath. The hot mixture is released into a chamber where the spirit vaporises and the residual heavy oil is separated from the aluminium sludge. A jet of the process gas is employed to facilitate the movement of the mixture through the coil and enter into the reaction. The operation is said to be continuous. R. P.

489. Pressure Oil Still. R. E. Humphreys. U.S.P. 1,582,929.

The still has two or more sets of cylindrical oil containers placed horizontally. Each set consists of an upper and a lower container, connected to each other by a number of short curved pipes along each side. The upper container of each set has a vapour outlet and the lower is connected at one end, by a conduit to a transverse drum situated beneath the forward end of the containers. Still lower a second drum lies beneath the rear end of the containers and is connected to the upper drum by means of a number of upwardly inclined tubes which pass through the heating chamber. The drums and containers are exterior to the heating chamber. A second conduit connects the lower drum to the rear end of the lower container.

Heat applied to the inclined tubes causes a circulation of oil in the system. A pressure of 250 lbs. is maintained and the temperature controlled to give the desired rate of conversion into spirit. R. P.

490. Art of Cracking Hydrocarbon Oils. E. W. Isom. U.S.P. 1,578,035, March 23, 1926.

An improved method of cracking hydrocarbon oil, which comprises circulating oil in a single pass through a heating conduit and thence to a reservoir, heating the oil circulating through the conduit to a cracking temperature by circulating heating gases thereover. Vapours of the cracked oil are taken off from the reservoir and are subjected to a refluxing operation, supplying reflux from the latter operation to the conduit at a point adjacent to the end of the conduit over which the heating gases first circulate. Fresh oil is supplied to the conduit at an intermediate point. Part of the heating gases which have passed over the conduit are recirculated together with fresh gas. The pressure in the conduit and reservoir may be anything between 20 and 300 pounds to the square inch; the temperature of the oil leaving the single pass heater may be from about 700° to 1,200° F. A. W. G.

491. Apparatus for Cracking (Hydrocarbon) Oils. K. V. King, Assr. to Standard Oil Co. U.S.P. 1,582,407, March 27, 1926. Appl. June 5th, 1925.

The retort or still is electro-plated with chromium internally in order to resist corrosive action during cracking operation. S. B.

492. Hydrocarbon Distillation. H. G. W. Kittredge. U.S.P. 1,561,169.

A cracking still installation is specified consisting of a source of heat and a pair of parallel horizontal reservoirs, the first being lower than the second. The first reservoir has an arched roof for exposure to heat, and a lower part shielded from the furnace. The second reservoir has a series of flues running across it medially, for the transmission of heat. Thus both reservoirs have a lower unheated part wherein coke and heavy residues may be deposited. The reservoirs are connected by a duct which connects the top of the first to the liquid level of the second and extends the length of the second in order to distribute the oil evenly. Raw oil is fed into the second still and circulated by means of a pump into the first still. A diphlegmator and condenser complete the apparatus. R. P.

493. Apparatus for the Decomposition (Cracking) of Heavy Hydrocarbons, Coal Tar, Pitch, etc., into Light Hydrocarbons and Carbon. W. Knapp and C. Steiding. E.P. 257,152. Dec. 24, 1925.

The still consists of three horizontal tubular retorts, the rear ends of which are each connected to a vapour outlet dipping into a boiler containing the oil or raw material. The retorts, which are heated to redness, enclose a cylindrical steel tube, fitted with a lid, which acts as the oil container, and the vapours pass out of the retort through the boiler to a condensing system. Any uncondensed gases are passed to a compressor and liquefiable consitutents separated. It is claimed that pure hydrocarbons are obtained and pure carbon left as a residue. S. B.

494. Art of Treating Oils. G. Kolsky. U.S.P. 1,598,973, 1926. Appl. Nov. 27, 1925.

The cracking and simultaneous hydrogenation of oils is effected by heating under pressure a mixture of the oil, ammonium halide and a finely divided metal like iron, zinc, aluminium or copper. The ammonia liberated and the iron chloride formed according to the equation :—

$$2NH_4Cl + Fe = FeCl_2 + 2NH_3 + H_2$$

are recovered and subsequently caused to react with the reformation of ammonium choride, as follows :—

$$FeCl_2 + 2NH_3 + 2H_2O = Fe(OH)_2 + 2NH_4Cl.$$

H. G. S.

495. Oil-Treating Apparatus. J. W. Lewis, Assr. to Atlantic Refining Co. U.S.P. 1,593,905, July 27th. Appl., July 6, 1922.

A vertical still with a tubular heat absorption structure is combined with a pressure still. The lower and upper ends of the tubes are connected to the vertical still at different levels, and the connections may be closed by valves. Pressure above atmospheric is maintained in this still and the tubes. Also, combined with a pressure still there is an oil chamber, connected with a heat absorption structure by a valve, with by-pass and check valve in by-pass. Pressure above atmospheric may be maintained in the chamber and heat absorption structure. H. M.

496. Apparatus for Cracking Oils. E. O. Linton. U.S. Patent No. 1,592,214.

The apparatus comprises vapourising chambers, consisting of cylindrical stills having inclined plates located in the upper part of the still, with their lower edges in proximity to the walls of the still. Perforated pipes are provided for delivering the oil above the plates, and residue can be withdrawn from the bottom of the still. No oil is allowed to accumulate in the stills, which may be used either for de-hydrating or vapourising purposes.

From the dome of each still vapour pipes rise through an expanding nozzle into a cracking retort mounted above the stills. From the retort the vapours pass into the condensing system. R. P.

497. Process of Distilling Oils with Volatile Catalysts. By A. M'c. D. McAfee. U.S. Patent 1,578,049, March 23, 1926.

The simultaneous manufacture of different grades of lower boiling hydrocarbons from higher boiling hydrocarbons with the aid of aluminium chloride, which comprises distilling the higher boiling hydrocarbons in the presence of aluminium chloride at 500°–550° F., passing the vapours at temperatures above 350° F. in the vapour line ultimately leading to a final condenser, and in the passage of such vapours bringing them into intimate contact with added higher boiling hydrocarbons, thus scrubbing out aluminium chloride present in said vapour. Such scrubbed-out aluminium chloride and added higher boiling hydrocarbons are refluxed back to the still. The vapours which have been so scrubbed are fractionally condensed, and enter the final condenser at temperatures above 350° F. A. W. G.

498. Process and Apparatus for Treating Hydrocarbon Oils. C. Matlock. U.S. Patent 1,591,428.

In this process the oil to be cracked is mixed with a small quantity of steam and passed through coils heated in a furnace to cracking temperature. The cracked vapours pass into a cooling chamber wherein a number of jets of water or cooling fluid are injected, and the vapours chilled to below cracking temperature. The vapours pass through a relief valve into a dephlegmator, which separates the hydrocarbons into different fractions. R. P.

498A. Process for Cracking Petroleum Oil. C. P. Dubbs. U.S. Patent 1,592,560.

This is an improvement of the Dubbs' process wherein the charging oil in a restricted stream is passed through the preheating coil, then united with the reflux oil and cracked. Thereafter the cracked oil is expanded into the reaction chambers. The vapours pass through the dephlegmator, throw down the reflux oil, and pass on to the condenser. R. P.

499. Apparatus for Cracking and Distillation of Petroleum. C. M. Page, Assr. to G. Fabyan. U.S.P. 1,597,476, Aug. 24, 1926. Appl. Aug. 26, 1920.

A cylindrical pressure still is provided with a number of closely situated vertical metallic surfaces, which are electrically heated. S. B.

500. Process of Cracking. A. J. Paris, jun. U.S. Patent 1,585,687.

The process consists of heating a hydrocarbon oil to a temperature below its boiling point, mixing the oil with a gas, or the oil and gas may be mixed before heating. The mixture is transferred to a compression cylinder wherein

it is subjected to a pressure sufficient to crack the oil, or the mixture may be compressed and heated under these conditions until the required change has taken place. The resultant products are cooled and separated, or may be admitted into another chamber and retained under the same pressure without cooling, then the vapourised portion passed through a condenser. An apparatus for operating the process is described. R. P.

501. Regulating Apparatus for Pressure Stills. D. Pyzel. U.S.P. 1,597,821, 1926. Appl., June 25, 1924.

An apparatus for the cracking of oil consists essentially of heating coils, expansion drum, dephlegmator and condenser. The oil which condenses in the dephlegmator, together with cracking stock introduced therein, falls into a stand pipe which is connected to the heating coils through a centrifugal pump. The latter is so constructed that it automatically maintains a constant level of oil in the stand-pipe. H. G. S.

502. Improvement in Pyrogenetic Manufacture of Gasoline. F. M. Rogers and M.G. Paulus. U.S.P. 1,599,100, 1926. Appl. July 21, 1919.

The gasoline produced by cracking under pressure is condensed under pressure, and the gases dissolved in it are taken off by slowly releasing the pressure. Economy is claimed. H. G. S.

503. Process of Refining (Cracking) Oil. B. V. Stoll. U.S.P. 1,593,275, 1926. Appl. October 26, 1922. *c.f.* U.S.P. 1,492,273, 1924.

The oil to be refined or cracked is pumped through heated coils at a temperature of 700 to 750° F. (370–400° C.) and under a pressure of 150 lbs. per sq. in., and is then expanded into a still at 100 lbs. per sq. in. pressure and at a temperature of 400–500° F. (205–260° C.). The heavy residue in the bottom of the still is continuously withdrawn and recycled, while the pressure distillate is taken through condensers. The oil leaving the coils may be by-passed through a tar-settling pot before entering the still. H. G. S.

504. Decomposition and Recombination of Hydrocarbons. A. T. Stuart and G. N. Middleton. U.S.P. 1,584,048.

An apparatus is claimed for the cracking of oils in the presence of hydrogen. It consists of an automatically-controlled electrically-heated reaction tube, suitably heat insulated, and enclosed in a jacket wherein a counter balancing pressure is maintained by means of a gaseous agent. Connected to the reaction tube there are a series of temperature controlled condensers and traps from which different fractions may be obtained and recycled or released from the system. From 2 per cent. to 4 per cent. of hydrogen is required to prevent carbon deposition, 40 per cent. of oil is recovered, 50 per cent. of which is light oil for refining and 50 per cent. for recycling. R. P.

505. Conversion of High-Boiling Hydrocarbon Oils into Lower-Boiling Oils. P. J. Sweeny, Assr. to Standard Oil Co. U.S.P. 1,589,908 of June 22. Appl. Jan. 11, 1926.

Oils in the gasoline range of boiling point are produced by passing the higher-boiling oil continuously in a restricted stream through a heating zone in which it is brought to conversion temperature. The heated oil is discharged into one of a number of series of connected enlarged chambers through which the oil flows at a slower rate, conversion temperature being maintained, and pressure maintained on the system. Liquid products are

withdrawn from a chamber remote from the one into which the oil flows from the heating zone. The flow of oil through the chambers is continued until substantial coke and asphaltic deposits take place in the later ones of the series. The oil is then caused to flow in the reverse direction through the chambers. H. M.

506. Method of Electrochemical Treatment of Unsaturated Hydrocarbon Compounds resulting from the Cracking of Oils. D. L. Thomas. U.S.P. 1,585,573 of May 18. Appl. Feb. 9, 1925.

Such compounds are subjected to the silent discharge of a high-tension electric current whilst under high pressure and at high temperature, to produce by combination of their molecules a stable product of different gravity and boiling point from the compound originally treated. H. M.

507. Process of Manufacturing Oil of a Low Boiling Point from Mineral Heavy Oils. Tsuguyoshi Mii, Assr. to Kotaro Isomura. U.S.P. 1,590,640 of June 29. Appl. Jan 19, 1923.

An aluminium hydrosilicate is impregnated with a soluble chloride to produce a catalyst for the manufacture of oils of low boiling point. H. M.

508. Improvements in or Relating to the Cracking and Hydrogenation of Hydrocarbon Oils. G. W. Wallace. E.P. 255,159, 1925.

Oils are cracked by passage in the vapour phase through and in counter-current to pieces of a material on which carbon is deposited. The material may consist of carbon in lumps or briquettes or of blocks of refractory material such as firebrick, alumina or the like, impregnated if desired with a catalyst such as nickel. Means are provided whereby the carbon deposited during cracking may be removed so that the material may be recycled. H. G. S.

Geological and Fields.

509. The Oil Regions of the Caspian Sea. *Pet. Times*, Aug. 7 and 14 1926, pp. 221–262.

The oil regions of the Caspain Sea can be divided into four main areas as follows :—

1. The Manghyshlak Peninsula. 2. The Island of Cheleken. 3. The District of the Nefte-dag and Boia-dag Mountains. 4. The District of the village Chikishlar, near the frontier between Russia and Persia.

1. The Manghyshlak Peninsula.—The central part of the peninsula lies at the intersection of 44° northern latitude and 22° eastern longitude; it is a flattened and fairly elevated country—200 metres above sea level. Two parallel ridges—Kara-tau and Ak-tau—extend from north-west to south-east for a distance of about 120 kilometres.

The following series of sediments are to be found in the peninsula :—1. Triassic, possibly even Permian, composed mainly of schists, sandstone, and limestone. 2. Jurassic, lower, middle, and upper. 3. Lower and Upper Cretaceous. 4. Tertiary, Paleogene and Neogene. 5. Post-Tertiary, comprising sediments of the Aralo-Caspian transgression.

The general stratigraphy of the area is exceedingly complicated and very varied with regard to the fauna and lithological characteristics of the rocks. The geological structure consists of a complicated anticlinal system accompanied by flexures and faults.

Oil indications have been discovered in a broad anticlinal valley formed by Cretaceous beds in the locality of Taspas. The lower Cretaceous rocks

here are impregnated with solid bitumen, but no fluid petroleum has yet been found. It is suggested that the Manghyshlak area be tested with the drill, after the completion of a detailed geological survey.

2. The Island of Cheleken.—Cheleken is the largest island in the Caspian sea, and is situated at the intersection of 39°.30′ northern latitude and 23° eastern longitude. The western side of the island is elevated, and a belt of hills extends along the longitudinal axis of the island. Large portions of the north western, eastern and south-eastern parts of the island are occupied by sand and salt lands.

A detailed geologic survey and map of the area was undertaken in 1907 by V. Veber and K. Kalitsky. The age of all the rocks is not established but they may be referred to the Paleogene series of the Tertiary system. The Baku beds are divided into two divisions, upper and lower, and cover a large area of the island. The upper beds are bituminous, but of no commercial value. Below the Baku beds and separated from them by an unconformity, are the sediments of the Apsheronian stage, with which the Tertiary system commences. The Apsheronian stage consists of upper, middle, and lower divisions, the last two being petroliferous.

Below the Apsheron beds are the Fish beds, which have been identified with the Akchaghyl stage. These are followed by the "rocks of the red-coloured formation, which is very characteristic as to its banded formation of brick-red marls. In vew of its stratigraphical correlations, this formation is considered to be indentical with the productive series of the Apsheron Peninsular. Oil is found in sands of the upper part of the formation, this being the only horizon of commercial importance within the island. The rocks of the red-coloured formation are widely outcropping and broken by intense faulting, owing to which they are far from being uniformly petoliferous throughout their extent. The most favourable conditions with regard to oil occurrence are in the western part of the interior tract of the island, deliminated by a line connecting the Tur-Tepe and Gheok-Chulba hills. Below the red-coloured formation lie the sediments of the Aligul locality, they consist of green argillaceous and calcareous rocks and sandstones probably of Oligocene age.

The geological structure of Cheleken is very complicated, but the main structural feature is an anticinal dome-like uplift which is stretched from south-west to north-east. However, the strata are so intensely faulted, that practically nothing of the dome has been left. The predominating directions of faulting are north-easterly and north-westerly, the latter direction being common to the western part of the area.

The characteristic feature of the Cheleken oil is a high paraffin content of from 5 to 10 per cent. The oil is black and viscous, with a specific gravity of 0·869—0·903 and setting point of + 2° C. — + 10° C. A lighter oil has been found, with a gravity of 0·849 and a spirit content of 15 per cent.

W. H. T.

510. THE KERTCH-TAMAN OIL REGION. Prof. V. Olruchev. *Pet. Times*, pp. 397, 473 and 571. Sept. 4, 11 and 25, 1926.

The Kertch-Taman Oil Region comprises two peninsulas:—The Kertch Peninsula, which forms the eastern part of the Crimean Peninsula, and the other, the Taman Peninsula, which forms a part of the Caucasian Isthmus, projecting westward. The two peninsulas, projecting from opposite sides towards each other, separate the Sea of Azov from the Black Sea and are themselves separated by the narrow Strait of Kertch. Owing to its position between two seas this region is very accessible, as the shores of the peninsula offer several bays which are suitable for the construction of harbours. The

Kertch Peninsula is nearly 100 kilometres long and from 20 to 45 kilometres wide. In the northern and north-eastern part of the peninsula ridges stretch in a latitudinal direction. In the south-eastern part of the peninsula they extend in a north-eastern direction. Mud volcanoes are to be found in places on the ridges and in the valleys. The Taman Peninsula is about 60 kilometres long and 35–45 kilometres wide, the total area being considerably smaller than that of the Kertch Peninsula. The country consists of flat plains and valleys gently rising towards separate flat cone-shape hills and short ridges. Both peninsulas are composed of nearly identical sedimentary rocks belonging to the Tertiary and post-Tertiary deposits. Igneous rocks are absent and the geological structure is comparatively simple. Comparing the two peninsulas it is noted that a greater variety of rocks can be found in the Kertch Peninsula, while on the Taman clays predominate. The Kertch Peninsula is sharply divided into two parts by the Parpach ridge, which in the west stretches almost in an east to west direction, afterwards turning abruptly to the south. Within the arc of the ridge are exposed the oldest formations. The lower dark clays of the Maikop strata are covered in places with remnants of later formations, such as the Chokrak, Sarmation and Pontain and below these formations Upper Eocene Marl beds appear. The Chokrak limestone crops out everywhere along the Parpach ridge. On the eastern part of the peninsula are spread formations of all the stages of the upper Tertiary system, the latter predominating in the valleys. There is no such sharp sub-division of the rocks on the Taman Peninsula. Most of the stages of the upper Tertiary system are developed. The older formations, the Sarmation and partly the Second Mediterranean, occur chiefly on the ridges and single hills, while on their slopes and in valleys Pliocene formations are found. The oldest Maikop formation is only exposed in a few places—on the tops of some dome-shaped hills and on the shore of the Sea of Azov. The geological structure of both peninsulas is as follows :— On the Kertch Peninsula the Parpach ridge forms a monoclinal fold, with gentle north and east slopes, together with steep south and west slopes. On the south-west plain lying within this ridge four flat anticlines are supposed to have existed. The northern part of the peninsula is composed of east to west anticlinal folds, which correspond to the general trend of the ridges. The number of these folds increases from west to east, and the folds belong in general to the type of elongated domes. In some of these anticlines there are depressions on the crest which gave rise to minor anticlines and synclines. The faults which are connected with the folding are reverse, faults occurring along the longtitudinal fissure, which dips gently in the same direction as the strata. Normal faults apparently constitute a structural feature of the land relief and gave rise to the formation of the Strait of Kertch. On the Taman Peninsula there are flat conical hills and short ridges forming elongated domes. Between these ridges there are wide synclinal valleys. The Kertch-Taman folds are considered to be the extreme north-west waves of the Caucasian uplevel. The Parpach ridge, which breaks the folding on the Kertch Peninsula, is apparently connected with the fact that beneath the south-western plain there lie the more strongly disturbed strata of Eocene and Cretaceous age. These strata formed an underground abutment which stopped the development of the Kertch-Taman folding. The Parpach ridge formed around this abutment, while the normal folds extend north and east of it. There are 36 locations on the Kertch Peninsula where indications of oil, such as seepages, asphalt impregnations, mud volcanoes, and sulphurous springs are to be found. At 14 of these locations wells have been sunk, and in most cases, oil has been produced. The Taman Peninsula has 23 locations where similar oil indications have

been identified. The association of oil indications with mud volcanoes is most pronounced on the Taman Peninsula where almost every mud volcano issues oil together with gas and salt water. On the Kertch Peninsula, where there are fewer mud volcanoes, the oil indications are associated also with the eroded crests of anticlinal folds, converted into anticlinal valleys. There appears to be a definite relationship between the oil indications and the anticlinal folds, which are mainly elongated domes of various lengths and breadths. A number of these folds, especially on the Kertch Peninsula, belong to a normal type, while the remainder may be classed as "diapir" folds, *i.e.*, with a perforating core compound of older strata that have broken the overlying younger ones. The mud volcanoes appear to be located on the crests of the anticlines, and their position is due to the fact that the crests of the folds are the most favourable parts of the structure for the accumulation of petroleum. On the Kertch Peninsula the oil is most frequently derived from clays of the Maikop beds of the lower Miocene and Oligocene. Oil is also yielded by the Chokrak limestone and Spaniodon beds (Middle Miocene) as well as by the marls, clays and bryozoan limestone of the Sarmatian (Upper Miocene), and in one case by the Meotic beds. On the Taman Peninsula oil comes from beds of still more various ages, beginning with the Maikop beds and ending with the post-Tertiary sands. According to very scanty information the oil on the Kertch Peninsula is in general a light one, and somewhat heavier on the Taman Peninsula. On both peninsulas the oil is distributed through the strata in conformity with its specific gravity, *i.e.*, the heavier oil lies at deeper horizons. W. H. T.

511. Geochemical Relations between Petroleum, Silica and Water. By P. G. Nutting. *Econ. Geol.*, 1926, No. 3.

The article deals with the relations of underground petroleum to the water and sand with which it is usually associated, the whole subject being closely connected with the recovery of petroleum from oil sands. The solubility of water in petroleum has been shown to be in the order of ·02 per cent. at ordinary temperatures and pressures. Variations in the type of petroleum do not appear to affect this figure, but under certain conditions of temperature and pressure, indications of chemical combination are apparent. Oil is also soluble in water to the extent of ·02 per cent., and is practically independent of saturation or density. Silica is a powerful adsorbent of both water and certain components of petroleum, and it is known that surface reactions between the silica and the adsorbed layer frequently take place.

If a quantity of clean washed sand be covered with a thin layer of water, and crude oil poured on to the latter, it will be noticed that very small drops of oil shortly appear on the surface of the sand. The oil therefore must have dissolved in the water, migrated downwards and then become deposited on the sand. The light brown skin which forms at the interface of oil and water is apparently formed by the hydrolysis of the oil by the water, whereby the terminal hydrogen atoms of the chain hydrocarbons are replaced by the O H radicle derived from the water. This reaction is inhibited by the addition of a salt of a strong base and a weak acid such as sodium carbonate.

Silica surfaces are found to adsorb from air a coat of moisture of about 100 molecules thick. For fine sand, this amounts to about 1 milligram per gramme of silica, and the ratio of adsorbed moisture to silica varies inversely as the size of the particles. The author suggests that adsorbed water enters into combination with the silica surface, forming silicic acids which are combinations of silica and hydroxyl radicles. If oil saturated sand be thoroughly washed with a suitable solvent and then dried, it will be found

to contain a small quantity of hydrocarbon which can only be removed by roasting. This residue of oil is evidently strongly adsorbed on to the sand particles. Again, when white sand is left in contact with highly refined petroleum, some of the silica particles become dark brown in colour, and the discolouration cannot be removed entirely, even by roasting.

The author describes various experiments which illustrate the fact that water will readily remove oil from sand grains, and that the action is accelerated by the addition of sodium carbonate solution. This last fact is important from the point of view of oil production, and can be taken advantage of in order to obtain a high percentage of recovery from oil sands.

The author concludes his article by showing that silica and silicates may be looked upon as: (1) Catalysts in aiding the production and maintenance of equilibrium between the various components of petroleum; and (2) as filters for restraining the movements of components of high carbon ratio.

W. H. T.

512. INTERPRETING EARTH TEMPERATURES. C. E. Van Orstrand. *Oil and Gas J.*, p. 72, Aug. 26, 1926.

The article deals with an attempt to correlate temperatures in deep oil wells with depth, and to find the relationship between temperature and geological structure.

The results of a great number of observations of temperatures in deep wells point to the conclusion that the depth-temperature curves in regions underlaid by sedimentary strata of great thickness, approximate in a few cases to straight lines.

The typical curve, however, is convex towards the axis of depth. So persistently does this type of smooth convex curve prevail in areas of deep sediments that departures from the normal type may be regarded at once as indications of unusual structural conditions.

Abnormal temperatures can be produced by a flow of gas into a well at a given level.

Highly fractured zones, zones of faulting and zones containing igneous rocks also give results which vary considerably from the normal type. In the case of granite rocks, the variation can be explained by the differences in thermal diffusivity of granite as compared with that of sediments. The temperature gradient diminishes as granite is approached, and the flattening of the depth-temperature curve with increasing depth may thus serve to give some idea of the thickness of the sediments through which the well is being driven.

The depth-temperature curves in ancient lava flows are likely to be very erratic, and are usually a combination of very steep and very flat gradients.

It is stated that the temperature gradient of a well does not set up convection currents in the oil which is being produced, but that the oil merely acquires the temperature of the rock at whatever level it happens to be.

Depth-temperature curves may be correlated with structure in areas where the curves are of the smooth convex type. One method of correlation consists of plotting the reciprocal gradients on a structure map. The reciprocal gradient is the number of feet in depth which is required to produce an increase in temperature of 1° Fahr.

In the majority of cases the smallest numbers are found near the crest of dome structures. The numbers increase with regularity as the distance from the top of the dome increases.

Another method of correlation is to plot on a structure map, lines representing the depths at which certain definite temperatures are reached.

Rocks containing water, or strata inclined to the horizontal permit more heat to escape from the interior of the earth, than do horizontal strata or strata saturated with oil. The steepest gradients will be found in strata possessing the lowest conducting power. W. H. T.

513. Core Drilling with "Volumit." *Petr. Times*, p. 1,078, June 26, 1926.

The article deals with a substance called "volumit," which is a substitute for the diamond in core drilling.

A paper was read by Hans Richter, of Berlin, from which it may be gathered that not only is volumit an effective substitute for the diamond, but in some respects is preferable to it.

Volumit is produced at the very high temperature of about 3,000° C. The specific gravity is from 15·5 to 16, which suggests that tungsten with a specific gravity of about 17·4 is the main ingredient. The hardness on Moh's scale is 9·8 or 9·9 against 10 for the diamond.

It possesses one great advantage over the diamond in that it can be cast in any desired size or shape, and being tougher is more durable than the diamond. It has been found that the material can be used to the best advantage in tooth-like form.

From figures given, it appears that drilling with volumit can be carried out at little more than half the cost of drilling with diamonds. The speed of drilling using volumit is by no means inferior to the normal speed using diamonds. W. H. T.

514. Process for Separating Hydrocarbons from Oil-Bearing Earth. G. J. Rockwell. U.S.P. 1,594,796, Aug. 3, 1926.

A process and apparatus are described whereby all the hydrocarbons may be removed from oil-bearing earth. The material is agitated with water, and is heated at the same time by steam above atmospheric pressure. Some of the lighter hydrocarbons are thus distilled off and recovered, while the residual oil, being less viscous, is readily separated from the sand by attrition. For completing the separation of the oil from the sand violent agitation and heating at atmospheric pressure are resorted to. This permits stratification of the oil-water and clean sand, whereby final separation of the oil may be effected. W. H. T.

515. Process for the Separation of Hydrocarbons from Earthy Matter. James M. McClave. U.S.P. 1,594,625, Aug. 3, 1926.

The invention describes a process for separating hydrocarbons from sand, rock and other earthy matter. The crude material is treated with a suspension of an alkaline argillaceous earth in water to which may be added a small percentage of sodium silicate. The mineral Bentonite is the material which is found to be most suitable for the process. W. H. T.

516. Process for the Separation of Oil from Oil Sands and Other Like Material. N. S. Clarke. U.S.P. 1,592,179, July 13, 1926.

The patent describes a continuous process for removing oil from oil sands. The material is heated by the application of superheated steam and a suitable hydrocarbon gas. The resultant mixture is then agitated with water, and the oil and solid material drawn off. W. H. T.

Coal and Shale.

517. Synthesis of Petroleum from Gaseous Coal Products at the Ordinary Pressure. F. Fischer and H. Tropsch. *Brennstoff-Chemie*, 1926, 7, 97–104.

Whereas the catalytic reduction of carbon monoxide under high pressure leads to an oxygenated product (the oily mixture of alcohols and ketones known as "synthol"), at the ordinary pressure hydrocarbons only are produced; if a high temperature is employed methane is the sole product, but using metallic catalysts of the iron group at a low temperature of reaction, methane homologues are formed, liquid and partially solid hydrocarbon mixtures being obtained.

Finely divided iron or cobalt is superior to nickel. The iron catalyst is preferably prepared by reducing iron oxide with hydrogen at 350°–500°C., a little unreduced oxide being added subsequently. The rare earths, oxides of chromium, zinc, beryllium, uranium, or manganese, active or amorphous carbon, metallic palladium or copper, or iron oxide, are used as activators; mixtures of one part of oxide with from one to three parts of metal are suitable, an excess of oxide being undesirable. The addition of a caustic alkali (or alkali carbonate) to the catalyst raises the molecular weight of the hydrocarbon produced. The optimum reaction-temperatures are 300° C. with an iron catalyst, 270° with cobalt, and 160° C. with nickel. The velocity of reaction cannot be usefully increased by working at higher temperatures, because methane is then formed at the expense of its homologues. The formation of methane is suppressed by increasing the velocity of flow of the gases.

It was usual to employ water-gas (*i.e.*, a mixture of approximately equal parts of carbon monoxide and hydrogen) from which sulphur was first removed by catalytic conversion to hydrogen sulphide, which could then be removed in the usual way. Successful use has also been made of mixtures corresponding to generator gas and furnace gases.

Part of the hydrocarbons formed separates in the liquid state as soon as the reaction mixture has cooled sufficiently, but most remains as benzine vapours which may be recovered by the usual means (*e.g.*, adsorption, absorption, or compression and cooling). The most difficultly liquefiable portion contained ethane, propane, and butane; only traces of the corresponding olefines were present. Benzine, $d\frac{15°}{4°}$ 0·6718, was obtained as a water-white fluid, stable to light, by adsorption on active charcoal, which was then steamed; it commenced to boil below 20° C., and gave, for example, 75·3, 92·3, and 96·4 per cent. of distillate at 100°, 150°, and 180° C. respectively. A fraction of boiling range 170°–330° C., $d\frac{20°}{4°}$ 0·7804, was also obtained. Working with an iron-copper catalyst, activated by means of alkali, solid paraffin, set-point 61° C. was obtained, which was purified by washing with acetone and crystallisation from the same solvent.

The formation of such slightly volatile hydrocarbons causes the catalyst to become clogged, and therefore inactive. It may be revivified by steaming or by roasting in a current of air. W. S. N.

518. Distribution of Sulphur in Oil Shale. E. P. Harding and William Thordarson. *Ind. Eng. Chem.*, 1926, 18, 731–733.

This is an account of analyses made to determine, if possible, in what forms sulphur occurs in the shale from the Green River formation. The results

indicate that the sulphur is present as sulphides, sulphates and in combination with organic matter. S. F. B.

519. The Low-Temperature Carbonisation of Coal (III.). A. C. Fieldner. *Fuel*, 1926, **5**, 294–297; *c.f. J.*, 1926, **12**, 119–121A.

The Laing-Nielsen "Sensible" Heat Process consists in heating coal in a cylindrical, slightly inclined, rotating retort with hot producer gas, water-gas or reheated coal gas circulated through interior of retort. Heating gases enter retort at about 650–700° C. and leave at not below 150° C., the temperatures of the coal itself being 100 to 120 degrees below these temperatures.

Superheated steam processes labour under (i.) large heat losses due to latent heat of vaporisation combined with large condensing system; (ii.) cost of superheating equipment to resist corrosive action of steam.

Heating with molten lead.—Unavoidable loss of lead makes this method too expensive.

Two-stage processes.—The coal is preheated to destroy partially its coking properties and then charged into a carbonising retort proper. The Parr and Illingworth processes are typical. The former employs a vertical, cylindrical, externally heated retort into which the preheated coal is charged; the retort is then just sufficiently heated to cause the coal (high oxygen content) to carbonise autogenously. The Illingworth process preheats to improve coking property.

No single method of low-temperature carbonisation has met with unqualified technical success. Internal heating systems are simpler and cheaper, but are limited to feebly or non-coking coals; also gas is of low calorific value and light oils are not recoverable from gas. They are promising for future development in combination with power plants, etc. The more costly externally heated retorts will find use in making smokeless fuel from poorly coking coals in connection with a market for high B.Th.U. gas. H. G. S.

520. Process of and Apparatus for the Conversion of Crude Mineral or Shale Oil or Tar Oils into Light Oil or Spirit and for the Preparation of Light Oil or Spirit from Coal, Lignite or other Carbonaceous Material. E. Schultz. E.P. 254,011 of March 25, 1925.

Carbonaceous material is heated in a still or retort up to 760° F., or to a temperature sufficient to release all volatile matter, and the vapours conducted to a converter containing chemicals, such as common salt, zinc chloride or oxide, lime, zinc shavings, Bauxite, aluminium chloride or magnesia, and maintained at a temperature up to 660° F., but always at a lower temperature than the retort. A retort such as is described in E.P. 252,422 may be used. Or crude oil may be heated in a still and the vapours passed to a converter as described. The chemicals in the converter may be supported on a rotating screw or spiral. The vapours from the top of the converter, after passing through the chemicals, are passed to a condenser. The condensate is washed with acid and alkali and fractionally distilled. H. M.

521. Improvements in the Treatment of Hydrocarbon Oils. H. Schlamp. E.P. 255,777 of March 30, 1926.

The mixture of hydrocarbons obtained in the recovery of by-products from the distillation of coal, lignite, peat, etc., or similar products formed in the purification of petroleum, is treated, after the removal of phenol and

pyridine by washing, with sulphuric acid or sulphurous acid. A neutralising medium, such as ammonia solution or alkaline carbonate, is added, and the heat of reaction effects the distillation of the more volatile hydrocarbons. The carbon dioxide liberated may be used for the separation of the phenols from the soda-phenol lye. The contents of the vessel are allowed to stand, and the different products separate in layers. The operation is carried out in one vessel provided with stirring apparatus, and the products of neutralisation are of commercial value. H. M.

ABSTRACTS OF PAPERS READ BEFORE THE DIVISION OF PETROLEUM CHEMISTRY OF THE AMERICAN CHEMICAL SOCIETY AT TULSA, APRIL 5TH–9TH, 1926.

THE DETERMINATION OF THE UNSATURATED, AROMATIC, NAPHTHENE, AND PARAFFIN HYDROCARBONS IN MOTOR FUELS AND THEIR AUTOMOTIVE EQUIVALENTS. G. Egloff and J. C. Morrell.

See abstract No. 262. (Vol. 12.)

THE EFFECT OF PRESSURE AND TEMPERATURE ON THE TOTAL VOLUME OF PARTIALLY VAPOURISED MID-CONTINENT CRUDE. R. E. Wilson and H. G. Schnetyler.

See abstract No. 237. (Vol. 12.)

522. RESEARCH IN THE PETROLEUM INDUSTRY. B. T. Brooks. *Ind. Eng. Chem.*, 1926, **18**, 518–523.

In consideration of the recent bequests of John D. Rockefeller and the Universal Oil Products Co., amounting to $500,000, for the promotion of fundamental research relating to petroleum, it seems desirable that a few indications of the typical lines of investigation needed in this field should be made. Fundamental work may easily seem so far from refinery practice that it appears to have no other value than to satisfy scientific curiosity. Although to a certain extent this may be true, there is little doubt that much information of great value to the refiner is derived from such work. Practically all the petroleum produced to-day is used as fuel, only a relatively small amount being employed for other purposes, *e.g.*, lubrication. It is therefore inconceivable that any chemical uses for petroleum will ever be found to compare with these requirements. At the same time the manufacture of a greater diversity of products and the better use of by-products must tend to stabilise the whole industry and reduce the economic fluctuations (caused primarily by uncontrolled production) from which it now suffers. Roughly the lines of fundamental investigation needed fall under four headings :—

1. Geological history of petroleum.
2. Investigations on present refinery products and processes.
3. The chemistry of hydrocarbons and the study of individual hydrocarbons which occur in petroleum.
4. Study of shale oils and oils from the low-temperature carbonisation of coal.

The origin of petroleum has been the cause of much controversy and very little research. Chemical investigations of geologically recent deposits should yield much valuable information and aid considerably in the elucidation of this difficult problem.

Other investigations falling under this heading include the study of the destructive distillation and anaerobic fermentation of fats. Investigations on refinery products and processes would probably conflict with or duplicate similar work carried out by the oil companies themselves, and the author considers that most of this work should be left to them. In this connection however, the adaptation of laboratory methods to refinery practice must be mentioned, an excellent example being the use of high vacua for the distillation of lubricating oils. This process has been used for many years in the laboratory and yet is only just finding practical application on the large scale. Much work has yet to be done in connection with the properties of lubricating oils, the cause of the lubricating properties, and also of the fluorescence generally exhibited by them, being only slightly understood.

Very little is known of the behaviour of the individual hydrocarbons, most of the information available being incorrect and misleading. Problems in this connection include the tendency of the hydrocarbons to oxidise and form gums, the nature of the products formed, cracking reactions, the production of alcohols from the hydrocarbons, possible uses for nitroparaffins and the reactions of the hydrocarbons with sulphur. Practically nothing is known concerning any of these problems. Finally, it must be remembered that these investigations must considerably benefit organic chemistry, which is the basis of so many industrial processes, and thereby help to solve many other problems connected with industry. S. F. B.

523. Pure Hydrocarbons from Petroleum. G. G. Brown and A. R. Carr. *Ind. Eng. Chem.*, 1926, **18**, 718–721.

A study of the early work on the separation of petroleum into its constituents shows clearly that efficient fractionation can only be accomplished by the use of a column, a fact which can be deduced theoretically by using Leslie's method of reasoning (Motor Fuels, p. 114). The same deductions also show why the ideal fractionating column must be more efficient than the ideal simple dephlegmator or the differential dephlegmator. The authors have therefore employed simple fractionating columns without analysers in their attempt to prepare pure hydrocarbons from the commercial gasoline produced in the Cabin Creek Field by fractionation and have obtained excellent results. The initial fractionations were carried out in a still of 15-gallons capacity fitted with an iron column 18 ft. high and packed with modified Raschig rings, ¼-in. in diameter. Heat was supplied to the oil by a coil of electrically-heated reistance wire, situated in the still. As fractionation proceeded and the volume of the fractions decreased, a smaler still of 10-gallons capacity fitted with a 10 ft. column packed with ¼-in. rings was employed.

For the final distillation a 2-litre glass still with a 5 ft. glass column packed with ¼ in. rings was used. By systematic fractionation it was found that five fractionations were sufficient to separate any *cyclo*pentane, *cyclo*hexane, benzene or toluene present from the pentanes and hexanes, and that this number of fractionations gave 200 c.c. of *iso*pentane, bp. 30·5°–30·6° C. and 2500 c.c. of *n*-pentane, bp. 36·2°–36·3° C.

Seven fractionations gave 300 c.c. of *iso*hexane, bp. 61·1–61·2° C., and 1000 c.c. *n*-hexane, bp. 68·9 to 69° C. After nine fractionations 2000 c.c. of *n*-heptane were isolated, boiling between 98·6 and 98·7°C. Ten fractionations were necessary for the isolation of *iso*-octane, of which 2500 c.c. were obtained, boiling between 117·9° and 118·1° C. and a similar number of fractionations gave 1100 c.c. *n*-octane, bp. 124·3°–124·5° C. and 600 c.c. of

n-nonane, bp. 150·2°–150·9° C. Indications of the presence of butane, *cyclo*pentane, *iso*heptanes, *iso*nonanes, *iso*decanes, benzene and toluene were obtained.

From these results the authors consider that although their columns were not so efficient as properly designed bubble-cap plate columns, it is possible to isolate pure hydrocarbons with boiling points up to 150° C. by means of them. They also conclude that for efficient fractionation the columns must be well insulated, a large part of the condensate must be returned or refluxed to the top of the column, and that distillation must proceed slowly, the heat applied being carefully controlled. S. F. B.

524. The Separation of the Less Volatile Constituents of Petroleum. H. M. Smith. (Preliminary Report published by the Bureau of Mines).

An account is given of the preliminary work carried out in devising a method for separating the less volatile hydrocarbons present in crude petroleum. The starting material selected was crude oil from the Salt Creek, Wyoming, this being chosen because an ample supply of known history is available and because it is typical of the oil produced in the Rocky Mountain District and in part of the Mid-Continent fields. The Bureau of Mines has already made a semi-commercal analysis of this oil, a fact of considerable importance, as it affords a means of correlating the properties of commercial products with those of the actual components of the oil. In devising the actual method to be used for the separation, it is at once obvious that distillation must be precluded owing to its tendency to produce molecular rearrangement, cracking, etc. Previous work on paraffin wax indicated the value of the method of fractional extraction by means of a suitable solvent, such as acetone or chloroform, and this method has been adopted for the present work. In order to use acetone successfully all gasoline must be removed from the oil as it considerably alters the solvent action and interferes with its recovery as a pure solvent. The first stage therefore consisted in finding a method for removing the gasoline from the oil without undue heating. The apparatus employed for this purpose consisted of two vertical Liebig' condensers attached to each other. Steam was passed through the outside jackets from the lower condenser to the upper and served to heat the oil, which was allowed to flow slowly down the inner tubes. The gasoline was carried away by passing a stream of pre-heated natural gas in a counter current direction to the oil and at a constant pressure. The topped oil produced in this way showed an initial boiling point of 235° C. The actual extraction was carried out in a large extractor in such a manner that the solvent came into contact with the oil slightly below its boiling point. The oil was spread over a large surface by packing the extractor with cotton wool. The extraction was then carried on until the acetone leaving the cotton wool was colourless. The cotton wool was then carefully spread out to dry and when free from acetone, extracted with chloroform. The next stage in the separation is to separate the solids from the liquids. To do this the acetone solution is heated to 50° and poured into a large volume of acetone cooled to at least 10° C. After some time the precipitated solid is collected, dissolved in a little hot acetone and the process repeated. This operation is repeated several times. The solid eventually obtained contains both the crystalline and amorphous waxes, which are freed from acetone by warming on a water bath under reduced pressure. If it is desired to separate the crystalline from the amorphous solids the following method is employed. The crude residue obtained in the manner described above is

treated with several litres of acetone at 55° C. On cooling slightly the amorphous wax separates out and solidifies.

The warm acetone which contains the crystalline wax is then decanted off and chilled. This procedure is then repeated several times and gives a fairly complete separation of the two solids. The filtrates containing the acetone-soluble oils are concentrated under reduced pressure, the last traces of acetone being removed in a vacuum. The oil obtained by the author in this way was a green-brown oil of low viscosity, having $d\ \frac{15}{15}$ 0·885.

The chloroform extract contains hard asphaltic material, which is recovered by removing the solvent on the water bath. The result of a typical separation carried out on the Salt Creek oil in this manner gave: gasoline 33·9 per cent.; gasoline-free oil and solids, 43·4 per cent.; crystalline solids, 8·8 per cent.; amorphous solids, 11.5 per cent. S. F. B.

525. The Aliphatic Tertiary Alcohols and Their Industrial Possibilities. H. S. Davis and W. J. Murray. *Ind. Eng. Chem.*, 1926, 18, 844–846.

Aliphatic tertiary alcohols are now being prepared on a large scale by a process developed in the authors' laboratory, the raw material being olefines produced in quantity from petroleum by a new cracking process. The physical properties of these alcohols, notably their solvent action, are quite different from those of the corresponding straight chain isomerides and they should therefore prove invaluable as solvents, particularly for the crystallisation of certain substances, such as hydroxy acids, *e.g.*, citric acid. In boiling point they generally correspond with second lower straight chain alcohol; thus *tert*-butanol corresponds in boiling point with ethanol and *tert*-pentanol with *n*-propanol. Their chemical properties are also unique. They are highly resistant to oxidation and to the action of halogens, and their hydroxyl group is extraordinarily reactive; these substances therefore possess great possibilities with regard to organic syntheses. So far no definite examination of their physiological properties has been made, but the tertiary group seems to be related to such phenomena as musk-like odour, hypnotic effect and possibly vitamine power. S. F. B.

526. Assay of Non-Detonating Properties by Fractional Gravity Distillation. G. H. Clay.

The paper presents the results of engine tests and fractional gravity distillation, analyses of two samples of gasoline, and two artificial samples made by fractionating and blending the original samples.

Non-detonating properties were determined comparatively by means of a variable compression engine and compared with the "fractional-gravity" figures. A consideration of the results obtained shows that hydrocarbons of high specific gravity, particularly in the upper boiling range, give superior anti-knock qualities. W. H. T.

527. Properties of Gasoline Hydrocarbons from Tonkawa Crude Oil. N. A. Stephens.

The gasoline upon which the experiments were carried out was obtained from a mixed base crude oil of the following constants: sp. gr. ·814, asphalt content 2·4 per cent.—3·07 per cent., wax 8 per cent.—9 per cent., gasoline content 45 per cent. (sp. gr. ·750).

The gasoline was carefully fractionated, and determinations of (1) heat of vaporisation, (2) molecular weight, (3) specific heat, (4) coefficient of expansion, (5) ratio between volumes of vapour phase and liquid phase, (6) molecular refraction, (7) boiling point were carried out.

It was found from a consideration of the results obtained that the gasoline hydrocarbons of the crude oil represent mostly paraffins in the following proportions :—

C_5H_{12}—5·03%, C_6H_{14}—15·16%, $C_7H_{14}+C_7H_{16}$—24·60%, $C_8H_{16}+C_8H_{14}$—15·75%, C_9H_{20}—9·10%, $C_{10}H_{22}+C_{11}H_{24}+C_{12}H_{26}$—25·86%.

It is stated that the fractions have higher specific gravities than the theoretical figures, this indicating the presence of a small quantity of cyclo-hydrocarbons. In the heptane and octane group there are present the corresponding olefines. W. H. T.

528. Desulphurising Effects of Sodium Hypochlorite on Naphtha Solutions of Organic Sulphur Compounds. A. E. Wood, A. R. Greene and R. W. Provine. *Ind. Eng. Chem.*, 1926, **18**, 823-826.

The authors have continued and extended previous work (*cf.* Wood, Lowy and Faragher, *Ind. Eng. Chem.*, 1924, **16**, 1116). A study has now been made of the desulphurising effects of solutions of sodium hypochlorite varying in available chlorine and in free alkali contents upon certain sulphur compounds dissolved in naphtha. The compounds examined were, ethyl, *n*-butyl and diphenyl sulphides, ethyl and *n*-propyl disulphides, ethyl, *n*-propyl and *iso*-amyl mercaptans carbon disulphide, hydrogen sulphide, elementary sulphur and thiophene. The sulphur contents of these solutions varied from 0.10—0.71 per cent. The tests were made by shaking 50 c.c. of the stock naphtha solutions for 1 hour with a definite volume of the hypochlorite solution depending on the available chlorine content of the solution employed. If the hypochlorite solution remained alkaline, the recovered naphtha was washed with water; dilute sodium hydroxide was employed when the hypochlorite had become acid during the action. The sulphur content of the treated naphtha solution as compared with the original content then gave the extent to which desulphurisation had occurred. The results obtained, using three hypochlorite solutions, substantially confirm the work of Birch and Norris (*J.C.S.*, 1925, **127**, 1934). Sulphur and thiophene were found to be unaffected.

Ethyl sulphide was found to be readily removed, a result only to be expected in view of the solubility of the sulphone in water. *n*-Butyl and diphenyl sulphides were removed much less readily, the oxidation being considerably affected by the alkali content of the hypochlorite solution. The actual removal of sulphur from the naphtha solutions of these substances was shown to depend on the solubility of the corresponding sulphones in the naphtha. The mercaptans were somewhat less readily removed than either the sulphides or disulphides. Oxidation was found to proceed in two stages and only the hypochlorite solutions of lower alkalinity carried the oxidation beyond the disulphide stage. Carbon disulphide was attacked to some extent by all the hypochlorite solutions employed; hydrogen sulphide was converted into sulphur, some of which was left in solution in the naphtha. Referring to the use of hypochlorite solutions industrially the authors point out that solutions of higher available chlorine content are recommended for use with straight run distillates than for cracked products, probably because the oxidation products from the cracked distillates are more likely to be acid in nature. It is also suggested that in the Dunstan and Brooks process, the reason for the more efficient refining action of the adsorptive earth after the distillate has

been treated with hypochlorite is because the oxidation products, i.e., sulphones, are more readily adsorbed than the original sulphides (*cf.*, Wood, Sheeley and Trusty, *Ind. Eng. Chem.*, 1926, **18**, 169). The value of an initial soda wash in removing hydrogen sulphide, and part of the mercaptans, is emphasised particularly if a non-corrosive elementary sulphur free spirit is required. Further experiments using much more dilute solutions of the sulphur compounds in naphtha were also made and the effective desulphurising power of a weak hypochlorite solution, comparable with those generally employed in refining cracked spirits, measured. The results indicated that the type of hypochlorite solution to be used with a petroleum distillate cannot be determined in advance of laboratory tests on the distillate in question and that if the compounds which produce acid products are present in very small amounts only, a small treatment with hypochlorite of low alkalinity and chlorine content will suffice to give a sweet gasoline.

S. F. B.

529. The Aromatic Hydrocarbon Content of Natural Gas Gasoline. A. M. Erskine. *Ind. Eng. Chem.*, 1926, **18**, 722–723.

The presence of small quantities of benzene, toluene and *m*-xylene in a sample of Pennsylvanian absorption natural gas gasoline, $d\ \frac{15{\cdot}56}{15{\cdot}56}$ 0·6619, has been proved as follows: 2000 c.c. of the sample were fractionated through a Hempel column and the aromatic hydrocarbons present in the various fractions obtained, concentrated by extraction with liquid sulphur dioxide. After removal of this solvent the fractions were nitrated and the aromatic hydrocarbons identified in the form of their nitro-derivatives. Quantitative determinations on the fractions using the nitro-benzene critical solution temperature method showed that the original sample contained 0·6 per cent. benzene, 0·6 per cent toluene and 1·2 per cent. *m*-xylene.

The residue, boiling about 124° C., which contained the xylene, was also found to contain roughly 1 per cent. of unsaturated hydrocarbons.

S. F. B.

530. The Precise Determination of Aromatic Hydrocarbons in Gasoline. A. M. Erskine, *Ind. Eng. Chem.*, 1926, **18**, 694–696.

The use of nitro-benzene instead of aniline as a means of determining aromatic hydrocarbons present in gasoline has been studied. With this reagent also the lowering of the critical temperature of solution is found to be proportional to the percentage weight of aromatics present, but whereas aniline gives a solution temperature corresponding to the b.p. of some of the paraffins present, nitrobenzene gives a solution temperature below 20° C.

It was found that equal weights of gasoline and nitrobenzene gave the critical solution temperature, and the procedure adopted was to introduce equal weights by means of a pipette graduated to ·05 c.c. into a test-tube, which is subsequently sealed. These tubes are then agitated in a temperature-controlled bath, and by slow heating and cooling the cloud point can be observed accurately to ·05° C. The operation is repeated after treatment of the sample with two volumes of 98 per cent. sulphuric acid, the difference in C.S.T. multiplied by a factor, giving the percentage of aromatic hydrocarbons present. If individual aromatic hydrocarbons are required the sample is fractionated into the usual cuts 50–95°, 95–124°, and a residue and each treated as above.

It was found that the acid treatment on the toluene and xylene fractions attacked the paraffin hydrocarbons to a certain extent also, with the result

that the C.S.T. was thereby raised ·60° and ·52° respectively. It is therefore necessary to deduct these amounts from the observed readings for these fractions.

The difference in C.S.T. before and after acid treatment multiplied by ·845 for benzene, ·890 for toluene, and ·938 for xylene, gives the percentage by weight of these hydrocarbons present up to a maximum of 20 per cent. As in the aniline method, the presence of unsaturated hydrocarbons vitiates the results, but it is stated that refluxing with aqueous mercuric acetate will remove these hydrocarbons.

The advantages of this method are the lower temperature employed and the degree of accuracy (±·2 per cent.) obtainable. S. B.

531. The Sharples Process.

The paper deals more with the recent developments of the Sharples Process than with its original underlying principles and details. By means of this process, it is possible to produce a finished lubricating oil of very low cold test, and also a far higher yield of finished bright stock than had previously been obtainable. The process is now used most extensively for dewaxing steam refined residues and also heavy distillates made by distilling crude oil down to pitch. The principal advantage is the increased yield of finished lubricant, and is due to the ability to remove wax without a preliminary destructive distillation. Under normal conditions, the wax contained in the oil is in the amorphous form, and in order to prepare the stock for pressing, the amorphous wax must be broken down by a cracking distillation to permit the formation of larger wax crystals. During this preliminary heat treatment, the oil as well as the wax is cracked, and thus much of the lubricating oil content is converted into material of no lubricating value. In the Sharples Process, however, the wax is removed in the amorphous form, thus obviating a distillation whereby lubricating oil is destroyed. It is estimated that whereas only one-third of the stock charged to the press is produced as a lubricant, the Sharples process returns at least 80 per cent. as lubricating oil. Apart from actual economies in oil, the process is stated to effect further savings with regard to handling and refining. Two instances of these secondary economies are given, namely, (1) the dewaxing of "long residuum" and (2) the dewaxing of "overhead amorphous distillate." Long residuum is the term applied to steam refined residuums which contain not only the material from which bright stock is made, but also that fraction which is ordinarily produced as a wax distillate. Where "long residuums" are Sharples processed the crude is reduced in the initial distillation either to a stock representing the entire lubricant of the crude, or to a residue meeting a heavy oil specification. The wax is then removed by Sharples centrifuges, and the resultant oil used as produced, or fractionated into neutral oils and heavier stocks. Prior to the development of this application of the process, all bright stocks were dewaxed by cold settling, and all neutral oils were dewaxed by pressing. In most cases, neither of the resulting products were suitable for immediate use, the neutrals being too light, and the bright stock too heavy. In other words, when bright stocks and neutrals were produced separately, the residue was first fractionated into two or more parts, and afterwards blended back again in order to produce the specified oils. The purpose of dewaxing "overhead amorphous distillate" is to produce a full series of lubricating oils from asphaltic crudes which cannot be handled in the form of long residuum. In the preparation of this type of material, the distillation is carried out so as to produce the entire lubricant in one cut, with the wax in an amorphous form. The Sharples process does not operate

satisfactorily on oils containing crystalline wax. The amorphous distillate is then dewaxed without further treatment, thus producing oils of low pour point. Subsequent fractionation will give a full series of lubricants. In this case, there is no decomposition of lubricating oil during distillation, and therefore there is no unnecessary subsequent refining of cracked material. The process does not preclude the production of finished paraffin wax, for the amorphous wax may be subjected to a cracking distillation, and converted into crystalline wax. W. H. T.

532. Wax Crystallisation. A Preliminary Report. F. W. Padgett, D. G. Hefley and A. Henriksen. *Ind. Eng. Chem.*, 1926, **18**, 832–835.

Two forms of wax are generally recognised, amorphous and crystalline. The former is precipitated from residual oils, but either or both forms may separate from distillate oils.' Two theories have been advanced to account for the two forms. According to one theory, based on colloid chemistry, both forms are regarded as crystalline, the difference in properties being due to difference in crystalline size caused by associated oils and asphaltic bodies. The second theory is that the amorphous wax is wholly or partially non-crystalline, a characteristic property of hydrocarbons with a branched chain. When these amorphous waxes are distilled under proper conditions, cracking or rearrangement of the molecule takes place with the formation of normal hydrocarbons which are crystalline. In order to determine if the amorphous waxes are really non-crystalline the authors have prepared a number of photomicrographs using polarised light. Observations on the crystallisation of various waxes were made by using a warm stage. As it was considered that crystallisation in thin films was not normal, the hanging drop slide was employed. Three forms of crystallisation were observed. The first is characteristic of residual oils, petroleum and heavy raw-wax distillates, the crystals being small and made to grow only with difficulty. These crystals, after numerous precipitations by acetone, separate as plates. The second type of crystallisation is found in slack wax and products such as ordinary commercial paraffin wax. Centres of crystallisation of various shapes appear from which fine needles then grow in all directions. The third type is characterised by the formation of plates or leaflets. From these preliminary results the authors conclude that the actual nature of the wax is of considerable importance in wax crystallisation, and also that the effect of other substances, such as asphalts, or the admixture of one wax with another must not be overlooked. Numerous photomicrographs are reproduced. S. F. B.

533. The Life of Fuller's Earth used in the Vapour-Phase Treatment of Cracked Distillates. M. R. Mandelbaum and P. S. Nisson. *Ind. Eng. Chem.*, 1926, **18**, 564–6.

Experiments have been carried out on the recovery of fuller's earth used in the vapour-phase refining of cracked gasoline in order to determine to what extent the earth deteriorated after frequent use. A typical Florida fuller's earth, ground to pass a 60 to 90 mesh, was used in a polymeriser of two pounds clay capacity attached to a 10-gallon still. The earth was revivified by burning at 549° C.

It was found that after five re-burnings, the efficiency of the fuller's earth was practically unaffected. H. G. S.

534. The Development of a Liquid-Phase Cracking Process. S. J. M. Auld and A. E. Dunstan. *Ind. Eng. Chem.*, **18**, 803.

This paper gives a description of the fundamental principles upon which the design of the A. D. H. Cracking Plant was based. The problem of maintaining the liquid phase and the factors which operate for and against this state are discussed, while the actual mechanism of cracking is also commented on. Experiments to determine the pressure solubility relations of the permanent gases and the heavy oils, and the relationship between oil temperatures, skin temperatures and furnace temperatures, were carried out in order to design the heating arrangements of the plant. Cracking experiments to determine the effects of temperature and time of heating on the yield of spirit and in the formation of coke were also carried out in an autoclave and in a continuous model plant.

The pressure solubility relations between gas and oil were determined in a modified Andrews apparatus wherein temperatures could be controlled within 1° C. up to 450° C., and it was possible to observe cracking taking place under pressures up to 1000 lb. per sq. in.

High pressure seems to limit the amount of gas and carbon formed and improves the quality of the spirit, but pressures of 25 to 35 atmospheres for gas oil and kerosene appear to be the optimum, since these give the advantages of high pressure without unduly increasing the cost of plant.

One of the most important points to be considered is the formation of coke. Carbon is a normal product of cracking and the general experience is that the higher the temperature used the greater is the quantity of carbon deposited. Two considerations complicate this effect. The first is the impossibility of raising the bulk of the oil to that desired temperature without overheating the portion of oil adjacent to the source of heat. The second is the difference in the rate of decomposition of each constituent of the oil for a given temperature.

This effect becomes more marked with rise in molecular weight and is particularly noticeable in the case of heavy asphaltic residues. It is, therefore, necessary that the skin temperature (*i.e.*, the temperature of the oil film adjacent to the metal wall through which the heat is supplied to the oil) be kept as low as possible. A study of skin temperatures was made and in order to reduce skin temperature to its practical minimum the method of heating in thin streams moving at low velocity was adopted.

Both static and dynamic cracking experiments showed that there is, within certain limits, a definite time temperature relationship corresponding to any determined extent of light spirit production. For practical reasons the limits for Persian gas oil are set at 380° and 450° and between these temperatures the yield of spirit is a function of the temperatures when the time is constant and is substantially doubled for every 10° rise. At constant temperature the yield is a linear function of the time in the early stages, but ceases to be so over longer periods.

The basic principles which have governed the development of this process may be summarised as follows :—

(*a*) The pressure should be high enough to maintain the oil to be cracked in the liquid condition and to reduce the amount of undissolved products of the reaction to the lowest point compatible with readily attainable practical conditions.

(*b*) The extent of decomposition should be deliberately restricted.

(*c*) For each oil there is a definite and fairly well defined narrow range of temperature at which appreciable cracking commences, above this temperature the rate of decomposition rapidly increases, the velocity of reaction being approximately doubled for every 10° rise in the early stages.

(*d*) There is a marked time factor which governs the production of light spirit and is displayed in two ways. There is an appreciable interval between the moment of attaining thermolytic temperature and observation of the formation of noticeable quantities of decomposition products, and the temperature of the oil must be maintained for a definite time if cracking is to proceed to the extent required. The rate of flow must, therefore, be a function of the temperature and correspondingly controlled.

(*e*) The oil should be heated in thin streams at low velocity to reduce furnace temperature and the skin temperature. The factor determining the limiting minimum velocity or the length of time that the oil is heated before passing into the carbon segregation area is the time interval mentioned above.

For the application of these principles separate heating and deposition zones are employed and the stages of treatment are three in number. In the first zone oil is heated to a point not more than 20° to 25° below the optimum temperature. This is the temperature at which the previously fixed extent of decomposition takes place.

In the second zone the oil is quickly heated to a temperature exceeding by about 20° the optimum temperature. This stage is important and must be carefully controlled, for it is here that advantage is taken of the time factor in order to give the oil its impetus towards disruption without materially altering its decomposition. This part of the apparatus is called the "thermalizer" and consists of a simple tube or tubes in parallel.

After leaving the "thermalizer" the oil passes into the third zone or "reactor," where it remains for the time necessary to attain the required extent of decomposition. A small amount of external heat is supplied to this section in order to make up the unavoidable loss due to radiation or other causes. R. P.

Abstracts.

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General.

535. Oil Concession on the Shirak Steppes. *The Oil Bulletin*, May 15th, 1925, No. 10, p. 12.

An Italian-Belgian company has concluded a concessionary agreement with the Georgian S.S.R. Government, the terms of which give the company the right to select three oil sections of 125 desiatines each on the Georgian Shirak oil-bearing steppe. During 1½ years the concessionaires are allotted 30 desiatines on each section for exploitation. Upon termination of the prospecting term, the obligatory minimum production and drilling are established, by mutual agreement, for 5 years. The concession is for 30 years. The concessionaires pay, twice a year, 15 per cent. of the gross production. The Georgian Government retains the right to purchase 50 per cent. of the net production at rates ruling in the London market. The concessionaires have the right to export oil products under general conditions.

Workmen to be engaged in Georgia, but director-specialists and the higher technical staff (not exceeding 25 per cent. of total workmen and staff) may be foreigners.

In the event of breaking the agreement, all equipment, erections and 5000 roubles deposit are confiscated by the Government. Upon termination of the concession term, the industry is handed over to the Soviet Government without recompense. T. W.

536. Where to Erect Refining Works for Baku Oil. I. Strigeov. *The Mining Journal*, June, 1925, No. 6, p. 425.

As the hypothetical production of crude petroleum containing lubricants was 1·7 million tons for the ensuing year, while the throughput of the Baku refineries was only 1·2 million tons, the Baku Directorate of the Petroleum Industry concluded it to be indispensable to erect such works at Batoum and not Baku. The higher authorities have over-ruled this and decided to construct a lubricating oil battery at Baku. The article discusses this over-ruling and insists on the necessity of erecting the refineries at Batoum and sets out the author's views, which evidently are the same upon which the Baku Directorate based their conclusions.

Owing to the proposed increased production in the coming year, and still higher production in each ensuing year, it will be necessary to export petroleum products, as the internal market will not be able to absorb the increased surplus each year. To do this, the American example of long pipe-lines to the sea coast, and the erection at these terminals on the coast of topping plants and refineries with similar erections on a smaller scale in the interior for internal consumption should be followed. This system has proved to be the most economical.

Baku gravitates towards Batoum, and a pipe-line for crude should be laid parallel to the existing kerosine pipe-line. Pipe-line transport is 5 times

cheaper than rail, and if the required products are produced in Baku a large sum in excess must be paid for their freight.

The Baku petroleum-production has now outstripped the capabilities of the Baku refineries, which before 1914 could distil above 5 million tons of petroleum yearly, but now, being worn out, their capacity is only 3·2 million tons.

In Batoum there are reservoirs for 350,000 tons, and in any case the tank capacity must be increased, whether in Baku or Batoum, and it is more rational to pump the light fractions, while contained in their crude state, thus avoiding evaporation in their rectified condition whilst being transported in railway tank wagons.

In each of the main producing oilfields—Baku, Grosny and Emba—the refining of petroleum must gravitate toward the consumer, and for export large distilling works should be erected on the Black Sea Coast. A pipe-line from Grosny to the Black Sea should be constructed on the Northern side of the Caucasian range, and Emba could then deliver its production *via* Petrovsk, and have it distilled at the same point as Grosny and Maikop oil.

Small refining plants were erected before 1914 at Yaroslav, Nijni Novgorod, Moscow, Leningrad and Riga for the internal markets, so that even then the necessity had ripened in approaching the refining industry to the sale markets.

Azneft in the near future will erect two cracking plants for benzine, one by Vickers and the other by the American system, Cross. It is proposed to put up Cross's system in Batoum and Vickers' in Baku. It would be more rational to erect both at Batoum and pump the crude petroleum at 2 roubles 40 cop. per ton than to pay a railway freight 9 roubles 60 cop. per ton of benzine. T. W.

537. Emba District: Guriev-Dossor Railway (General News). *The Oil Bulletin*, May 1st, 1925, No. 9, p. 9.

Zugprom has granted Embaneft permission to construct a narrow gauge railway from Guriev to the Dossor oilfields, distance 90 versts, assigning 18 million roubles for this purpose.

The construction of this railway will solve the most important questions for Embaneft, the supply of water to the industrial district and the transport of goods. The expediency of economical grounds decided the question in this manner, and not by means of laying a pipe-line for water and taking measures to augment and improve the existing animal and motor transport.

The construction of the railway will decrease the present transport and water supply expenditure by 170,000 roubles yearly, and in comparison with a water pipe-line the saving will be 140,000 roubles. Besides this, the railway will be a basis of supply to the industrial district for 100 versts ahead and will lighten the prospecting work on new areas. The passenger traffic will also have a great influence, and the trust will secure more easily the necessary qualified workmen. T. W.

538. Effect of Dissolved Gas upon Viscosity and Surface Tension. C. E. Beecher and I. P. Parkhurst. *Oil & Gas J.*, 1926, **25** (22), 113.

At a temperature of 75° F. and a pressure of 500 lb., the viscosity of a given crude oil is reduced by about 50 per cent. when saturated with natural gas. Dissolved gas also reduces surface tension, and in the cases of two crudes at pressures of 400 to 500 lb., saturation with gas indicated a reduction in surface tension of about 20 per cent. It is believed that the flow of large volumes of oil through sands is only possible because of reduced viscosity and surface tension caused by gases in solution. A large percentage of oil

which present production methods fail to recover is held in the sand by capillarity, a force which increases as the dissolved gases escape and the surface tension rises. If this increase in surface tension could be prevented, a larger volume of oil should be recovered. G. S.

539. The Control of Flue Gases by Means of Carbon Dioxide Recorders. Julius Grant. *The Industrial Chemist*, October, 1926.

For the economic utilisation of fuel, control of the processes of combustion is important. An insufficient supply of air causes incomplete combustion, whereas excess of air cools the source of heat, both processes giving reduced heating efficiency.

The Federation of British Industries recommend the following equation as an indication of the heat wasted in flue stacks:—

$$\frac{\text{Actual temperature}-75}{2{\cdot}6\ CO_2+0{\cdot}75} = \text{percentage waste}$$

Thus the temperature of the gases and the carbon dioxide content are the variables in the equation. Methods of measuring the temperature were discussed in *The Industrial Chemist*, April, 1926.

Methods for determining the percentage of carbon dioxide into flue gases may be divided into chemical and physical.

The "Arkon" carbon dioxide recorder depends on the absorption of carbon dioxide by caustic potash. 100 c.c. of flue gases are forced into the absorption chamber. The residual gases exert a pressure which records the percentage of residual gases on a rotating drum. This apparatus works continuously and only needs attention when the absorption vessel is recharged.

The "Carbon Dioxide Thermoscope" has a special thermometer which registers the rise in temperature of a cartridge containing dry granular caustic soda when a known volume of flue gases is admitted. The thermometer is calibrated in percentages of carbon dioxide.

Another chemical recorder has barium hydroxide as an absorbent. The change of conductivity of the solution, owing to precipitation of barium carbonate, is used as an indication of the percentage of carbon dioxide in the gas.

The chief objections to chemical recorders are their fragility, the attention needed for recharging with chemicals and the time taken for a determination.

Changes in the physical constants of flue gases caused by variation in the carbon dioxide content are used in physical recorders.

The Ranarex recorder records changes in density of the flue gases directly in percentages of carbon dioxide.

Another type of recorder depends on changes in thermal conductivity of the flue gases compared with that of air. Platinum spirals heated to the same temperature are allowed to cool in atmospheres of air and flue gas. The wires are connected in an electrical circuit and a galvanometer deflection gives the percentage of carbon dioxide.

Other instruments depend on viscosity changes. K. B. R.

540. Fluid Flow and Friction in Pipe-Lines. W. G. Heltzel. *Oil and Gas J.*, October 7, 1926.

This paper contains a complete review of work on fluid friction. The basic work of Poiseulle, Reynolds and Stanton and Pannell is described without details of the experiments or mathematical elaboration. The well-known curve evolved by Stanton and Pannell showing the relation for stream-line and turbulent flow between "f" (the co-efficient of friction) and $\frac{v\ d\ D}{\eta}$, is given (v = linear velocity of flow; d = diameter of pipe; D = density; η = viscosity). Curves obtained for turbulent flow by Lander,

Saph and Schoder, and the author are compared with the Stanton-Pannell curve. The author thinks that when pipes of large diameter are used, the roughness of the pipe surface has only a very small effect on "f," and the value of this may therefore be deduced from the Stanton-Pannell curve, assuming v, d, D and η to be known.

The author's results, referred to above, were obtained by measurements on pipe-lines conveying crude oil.

The mechanism of flow in both stream-line and turbulent motion is described.

The determination of viscosity in standard instruments is referred to, and equations for the conversion of numbers so obtained, to the absolute viscosity, are given.

The two fundamental equations for stream-line and turbulent flow are given in forms which are useful for engineering calculations. From the equations in the forms given it is possible to calculate the resistance to flow through pipes of length one foot, one thousand feet, or one mile, when the throughput is known in either barrels per hour or cubic feet per second; the density being expressed in pounds per cubic foot and the pipe diameter in inches.

Several useful curves are given in the paper. These are: The Stanton-Pannell curve connecting the co-efficient of friction with $\frac{v\ d\ D}{\eta}$, a curve connecting the kinematic viscosity (*i.e.*, $\frac{\eta}{D}$) with the Saybolt, Engler or Redwood viscosity numbers; temperature-viscosity curves for various crude oils; density and viscosity of water over the range 0° C.—100° C.; viscosity of steam and air at various temperatures; a diagram giving the operating data of a pipe-line carrying crude oil covering a period of 15 months.

P. D.

541. Fluid Heat Transmission for High Temperatures. J. A. Reavell. *J. Soc. Chem. Ind.* Trans., 1926, Vol. 45, No. 45.

The term "heat transmission" is here used to denote the conveyance of heat from some type of generator to the point at which the heat is to be used. The methods in common use are: (1) Direct heating; (2) continuous flow of saturated steam; (3) continuous flow of superheated steam. (1) Does not give good temperature contro! ; (2) cannot be used for high temperatures (above 300° F.) on account of the high pressures involved; (3) has the disadvantage that steam has only a small heat capacity per cubic foot, and consequently a high velocity is necessary in the heating pipes. Many commercial processes need heaters working between 500° F. and 600° F., and the author recommends the use of oil to convey the heat.

The plant for use with oil is fully described and several specific cases are dealt with. The chief difficulty to be overcome is the tendency of the oil to "crack" in the heat generator, even when a special type of oil is employed. To prevent this the oil passes through the "absorber" or heat generator in thin pipes. By means of special control cocks, oil from the same generator may be delivered to different pieces of apparatus at different rates, thus making it easily possible to maintain the two pieces of apparatus at different temperatures.

P. D.

542. The Catalytic Formation of Petroleum Hydrocarbons from Fats. J. Marcusson and W. Bauerschäfer. *Petroleum*, 1926, 22, 815-816.

The conversion of fats takes place at lower temperatures than those employed by Mailhe, the products obtained by whom were secondary. By

keeping the temperature low and avoiding distillation heavy viscous oils are obtained as a primary product. The oil or fat was mixed with 1·5 its weight of kieselguhr or common salt and heated 20 hrs. to boiling point under reflux condenser, the temperature not exceeding 300° C. The product, freed from catalyst and saponifiable matter, was fluorescent, and had sp. gr. 0·92 to 0·87, and iodine value 52 to 29, according as linseed oil or tallow had been the raw material. The acetyl value was 13-16, and the acetyl value of the hydrogenated products 32-61. H. M.

543. Improvements in Cold Bituminous Paving Composition. O. H. Berger. E.P. 257,114, Aug. 26th, 1926.

The patent describes a bituminous mixture composed of hard asphalt and an approximately equal amount of oil flux, the latter containing a substantial percentage of relatively volatile material. The asphalt and fluxing oil are mixed at a temperature of between 200° and 250° Fahrenheit, and then further mixed with a warm mineral aggregate at practically the same temperature. The resulting asphaltic composition may then be laid cold without any further heating. W. H. T.

544. Oil Injection Engines. W. F. Joachim. *Automobile Engineer*, Oct., 1926.

The desiderata for a high speed Diesel engine are outlined, the need for a turbulent head and one in which the spray cloud fits the combustion space is emphasised. Experiments are described in which ultra high speed photographs of the formation of spray clouds (formed under Diesel engine conditions) show the progressive growth of the clouds and the modification of their shapes by using different jets.

The co-efficients of discharge of Diesel fuels was studied at high discharge pressures against varying back pressures; little is gained by using discharge pressures above 1000 lb. per sq. in., unless the back pressure equals approximately three-fifths of the hydraulic pressure.

The variation of vapour pressure with temperature was studied for various Diesel fuels using a heavy gas tight bomb.

With a view to the use of steel diaphragms as the flexible member in injection valves, the load capacity, deformation and hysteresis of suitable diaphragms was studied.

The performance and calibration of injection valves is described. Oil is discharged through the valve on to a rotating target.

Engine tests are described in which the information obtained from the above studies is transferred in actual practice. W. N. H.

545. The Variable-Compression Ratio Motor. A. L. Nugey. *Oil Trade J.*, Oct., 1926.

A single cylinder petrol motor is described, the piston is fitted with an angularity thrust eliminator. A large cylindrical pocket in the cylinder opposite the sparking plug is surrounded by a rotating sleeve valve. The compression ratio is altered by raising or lowering a large piston which occupies almost the entire head of the cylinder, a joint being made between cylinder and displacing piston by a special stuffing box. W. N. H.

546. Motor Fuel and Process of Producing Same. Joseph M. Hirsh. E.P. 258,913, May 5th, 1926.

A mixture of hydrogen and carbon monoxide is produced by passing air and steam through coal in an incandescent state, the mixture and the unde-

composed steam passing to a zone where nascent hydrogen is generated. The petroleum or similar hydrocarbon is subsequently saturated with the resulting gases. G. S.

547. Improvements in and Relating to Fuel for Use in Internal-Combustion Engines. J. Kewley. E.P. 259,314, Oct. 11th, 1926.

The improvement dealt with in this patent consists of adding to a kerosene or gasoline fuel, one-third of 1 per cent. of nickel carbonyl. By this means a "low compression fuel" can be converted into material suitable for use in engines with a high compression ratio. W. H. T.

Analysis and Testing.

548. Estimation of Hard Asphaltum in Dark Mineral Oils. D. Holde. *Petroleum*, 1926, **22**, 799-800.

Comparisons were made of the results obtained in estimating the hard asphalt content of two cylinder oils by (*a*) precipitation with petroleum spirit, dissolving the precipitate in benzene, evaporating, and repeated boiling with absolute alcohol to remove paraffin wax; (*b*) the same procedure and, after each boiling with alcohol, redissolving the precipitate in a little benzene, evaporating, and extracting with alcohol till the redissolved precipitate shows no traces of paraffin wax. A cylinder oil giving the value 0·19–0·24 by method (*a*), gave the value 0·1–0·11 by method (*b*), and the results were more concordant. H. M.

549. Methods of Determining the Specific Gravity of Natural Gas. Guy S. Mitchell. *The Refiner*. Sept., 1926.

In this paper the effusion method for determining the specific gravity of a gas is further discussed. The conditions for initial and final pressures are given, and the size and shape of orifice dealt with. A type of orifice tip least likely to be affected by draughts is described.

A chronograph method of timing which may be used when mercury is the confining liquid is also described. In connection with the chronograph, which is of the type used in many observatories, the reader is referred for full details to Campbell's Practical Astronomy. A diagram of the suggested system of wiring for use with this instrument is given.

The general conclusions arrived at in the two papers are:—That for accurate work the direct weighing method or the Gas Density Balance (Edwards) should be used. The calculation of specific gravity from chemical composition is only applicable in certain cases. The effusion method with water as the confining agent is easily managed and may be used in fields work as well as in laboratory. When it is used care must be taken to correct for presence of water vapour. The temperature must be constant and preferably not above 30° C., and the time of effusion 90–120 seconds. The orifice should be as regular as possible and free from burrs. Its diameter should be ·21 mm. A large head of water should be used as an initial condition and 1 to 2 inches of water as the head at the end of effusion.

In this paper a correction curve for water vapour at various temperatures is given. P. D.

550. Making Oil Tests at Gasoline Plants. *Oil and Gas Journal*. Sept. 16th, 1926, p. 159.

The article deals with various methods of carrying out distillation tests on oil used for absorbtion purposes in natural gasoline plants. The object

of the distillation test is to determine the percentage saturation of "lean" oil, and to estimate the percentage of gasoline held in "rich" oil. For the distillation of "lean" oil, the apparatus consists of a flat bottom spun copper flask of 6200 ccs capacity, fitted with a 13 inch glass dephlegmator containing copper chain. The condenser is constructed of brass tubing $\frac{1}{4}$ of an inch inside diameter and 40 inches in length, and is immersed in an ice and water bath. A 250 c.c. graduated cylinder surrounded with ice and water forms the reciever for the condensate. The uncondensed vapours can be drawn off and measured by means of a meter. The charge of oil is 4 litres, and should give sufficient distillate for accurate measurement, and determination of specific gravity. For the distillation of "rich" oils, the above apparatus alone does not give sufficient condensate to check the modern natural gasoline plant's data. The apparatus which has been found to give the best results for the distillation of "rich" oil is the same as that used for "lean" oil, but with the addition of an auxiliary low temperature condenser. This condenser consists of a 130 c.c. test tube immersed in a quart thermos bottle $\frac{1}{2}$ filled with solid carbon dioxide and gasoline. A glass adapter is placed in an inverted position in the test tube so that the small end can be supported by a loosely fitting cork in the top of the test tube. Uncondensed vapour from the iced receiver passes through the adapter, the condensed liquid falling to the bottom of the test tube, while the uncondensed vapours escape between the adapter and test tube, and pass through the loosely fitting cork. This method of distillation has several desirable features. In the first place, it checks plant production closely, and secondly, gives two readings concerning the oil saturation. The iced condensate might be termed "stable" gasoline, and the carbon dioxide snow product "wild" gasoline. It thus gives at least an indication as to any stabilisation being accomplished in the plant. W. H. T.

551. Gas Dissolved in a Liquid. A Method and Means for Measuring the Amount of. Harold Ashley Daynes and the Cambridge Instrument Co. E.P. 259,086, Jan. 22nd, 1926.

The quantity of gas held in solution by a liquid, e.g., oxygen in water, is determined by selecting a second gas, such as hydrogen, and scrubbing this with the gas-containing liquid. The scrubbed gas is passed to one compartment of a gas-comparing device, the second compartment of which is supplied with the untreated gas. G. S.

Distillation and Refining.

552. Process of Distillation. W. F. Faragher, W. A. Gruse, and F. H. Garner. U.S.P. 1,601,729, 1926. Appl. May 25th, 1921.

In the distillation of oil in vertical or horizontal stills, the oil is agitated by means of currents of gas and an arrangement of baffles so that more efficient distillation with less coke deposition is ensured. H. G. S.

553. Bubble Tray for Dephlegmators. F. E. Gilmore. U.S.P. 1,598,772.

A bubble tray of conventional design is fitted with small drains of the correct size so that the water collecting progressively on the tray is discharged on to the tray below, the rate of discharge being less than the rate of deposit of total liquid on the tray. The drains further serve to drain the trays completely on the discontinuance of the distillation. W. N. H.

554. Distilling Apparatus for Volatile Liquids. H. A. Hills. U.S.P. 1,604,353, Oct. 26th, 1926.

The invention relates to the distillation and purification of volatile solvents used in "dry cleaning" processes. The apparatus consists of a vertical cylindrical still, the top of which is conical in shape, and a condenser consisting of a number of tubes placed vertically in a suitable cooling tank. The bottom of the still is not horizontal, but is fitted at an angle of approximately 45 degrees with the vertical sides of the still. A steam nozzle is provided at the bottom of the inside of the still, which projects steam in a horizontal direction against the inclined base of the still. A sleeve surrounds the nozzle and is spaced from it so as to provide an annular space, while at the rear end of the sleeve, a pipe is attached which extends to the bottom of the still. The action of the steam passing from the nozzle is to draw the liquid from the bottom of the still, impart a swirling motion to it, and thus induce a definite circulation of the liquid which prevents the mechanical carrying over of impurities into the condenser. W. H. T.

555. Reflux Columns. W. W. Holland. U.S.P. 1,603,772, Oct. 19th, 1926.

A reflux fractionating column is described, which is fitted with a number of spaced horizontal plates. A plurality of open tubes of less than three-quarters of an inch in diameter are attached to the underside of each plate, and project downwards for at least one quarter of the distance between the plates. The spaces between the plates communicate solely through the open tubes. W. H. T.

556. Art of Continuous Distillation of Petroleum Oils. F. A. Howard. U.S.P. 1,606,075, Nov. 9th, 1926.

The patent describes a method and apparatus for distilling petroleum, in which the oil is first heated rapidly in a coil up to a temperature at which certain of its constituents are normally vapours. The heated oil is then discharged into a heated chamber, and forced to travel through a tortuous path in the vapour space of the chamber before mixing with the main bulk of oil. The vapours evolved from the oil travel counter current to the entering oil, and on leaving the still, pass to a condenser. Means are provided whereby oil may be withdrawn from the bottom of the still and pumped through a second preheating coil, and thence to a second still, and and so on. Steam may be employed to aid the distillation. W. H. T.

557. Apparatus for Distilling Decomposable Materials. W. K. Lewis. U.S.P. 1,599,824.

In this distillation apparatus, means are provided to prevent condensation of the vapours from the still. The vapour outlet is substantially unobstructed and a jacket, through which heated fluid may be passed to maintain the vapour temperature, is arranged about the outlet. No reflux oil is allowed to return to the still. R. P.

558. Process of Treating Oil. E. O. Linton. U.S.P. 1,599,777, 1926. Appl., Dec. 8th, 1920.

The process is mainly designed to treat heavy asphalt-base oils. The oil is delivered into a conical vessel, the bottom of which is perforated, the whole being enclosed in a still of special shape. The temperatures in the inner vessel and still are so adjusted that the asphaltic portion of the oil is not vaporised, but flows through the perforations and is continuously withdrawn from the bottom of the still. The vapours, substantially free from asphaltic matter, are condensed and, if desired, subjected to one or more re-distillations in plant of similar type. H. G. S.

559. Oil-Refining Still. F. C. Moore and P. Vandervort. U.S.P. 1,599,833, Sept. 14th, 1926.

A pipe still is described for use in "topping" systems, in which the pipes are arranged horizontally in two coils, one above the other. The coils are constructed of straight parallel sections, the ends of which are connected to return bends situated outside the heating zone. The return bends are set in pockets in the outside brickwork, and are covered by doors so that they are accessible for removal or repair. The whole system of coils is encased by fire brick in such a manner as to prevent the fire from coming into direct contact with the tubes. The furnace is horizontal and occupies a position below the two sections of tubes. The rear end of the combustion space is open and allows the hot gases to pass into the bottom of the rear half of the lower heating chamber. The gases are deflected upwards by means of a vertical baffle, and then pass into the upper heating chamber through an opening at the front end of the horizontal brickwork which separates the upper from the lower section. The products of combustion finally pass out of the system at the upper rear end of the top heating chamber. The oil to be distilled enters the system at the bottom of the coil and is ejected at the top. W. H. T.

560. Improvements in the Separation of the Lowest Boiling Constituents of a Mixture by Vacuum Distillation. A. Schmalenbach. E.P. 244,736, Sept. 16th, 1926.

The patent describes a process and apparatus for carrying out vacuum distillations for the recovery of low boiling liquids. The mixture is heated in an externally fired still, and the vapours passed into a condenser under a suitably reduced vacuum, and cooled if necessary by means of a freezing solution. The condensate is treated in a heated fractionating column fitted with a dephlegmator. The fractionation is carried out under a reduced vacuum corresponding to the altered vapour pressure relationships. The column and condenser may, if desired, be connected to the same vacuum pump as that connected to the still, but with the interposition of a pressure reducer. The vacuum pump is so controlled as to prevent the undue lowering of the vacuum by excessive vapour pressure of the condensate. Extraction of vapours not condensed in the cooler is effected between the condenser and vacuum pump by means of an absorbing liquid. A pre-heater is provided whereby the untreated mixture is heated by the vapours from the still. From the preheater, the mixture passes to an evaporating vessel under a vacuum corresponding to that of the fractionating column. The vapours from the evaporator are conducted into the bottom of the fractionating column, while the residual liquid flows to the still by way of a syphon.
W. H. T.

561. Condenser. F. T. Snyder. U.S.P. 1,605,793. Nov. 2nd, 1926.

The invention relates to the type of condenser in which a small amount of vapour is to be condensed out of a large volume of incondensible gas. The complete condenser consists of a number of vertical cylindrical towers, each fitted with a perforated partition across the lower portion. The partitions support the great number of small earthenware rings with which the towers are filled. The object of the filling is to expose the maximum amount of surface for each cubic foot of tower space. Cooling liquid is sprayed from the top of the tower over the mass of earthenware rings and comes into contact with the gas as it ascends. The liquid which condenses, falls to the bottom of the filling and runs through the perforated plate to a suitable receiver at the base of the tower. The towers are connected in series,

the uncondensed gas from the first tower passing to the bottom of the second, while the liquid from the last tower forms the cooling medium for the previous one, and so on. In this way, a counter current system is developed, and fractionation of the condensed constituents of the gas is effected. W. H. T.

562. Process of Refining Mineral Oil. T. Hellthaler. U.S.P. 1,601,753, Oct. 5th, 1926.

The process consists of treating mineral oils with anhydrous antimony halides. The reagent may be used either in solution in an inert substance, or precipitated upon solid finely distributed carriers. The treatment with antimony compounds is followed by one using basic bleaching earth. W. H. T.

563. Method of Separating Petroleum Sludge. I. Hechenbleikner and T. C. Oliver. U.S.P. 1,599,360.

Acid tar from petroleum refining is heated under pressure with water; this treatment leads to a separation of the sulphuric acid from the petroleum content of the tar. The treatment is carried out in a tall cylindrical steel vessel, lead lined with an innermost lining of acid-proof masonry. Steam and acid tar are charged into the bottom and the mechanically mixed acid and petroleum are drawn off a little below the top of the vessel. Pressure of about six atmospheres is used and temperatures about 360° F. The time of treatment is from 1 to 3 hours. W. N. H.

564. Purified Asphalt from Crude Petroleum. S. W. Moss, assr. to the de Laval Separator Co. U.S.P. 1,599,369.

By centrifuging the preheated crude oil immediately prior to distillation, an asphalt containing less than $\frac{1}{2}$ per cent. insoluble matter can be obtained. A further advantage is that the amount of foreign matter deposited in the stills is very appreciably diminished. Centrifuging is carried out at 200° F. W. N. H.

565. Refining of Petroleum Oils and Distillates. P. McMichael. U.S.P. 1,603,701, Oct. 19th, 1926.

The invention relates to an improved method for refining petroleum hydrocarbons, and more particularly relates to a method for refining light petroleum oils and distillates, especially gasoline-containing cracked oils and pressure distillates. The distillate boiling below 225° C. is agitated with a solution of an alkali, and subsequently treated with 1·5 to 15 per cent. of sulphuric acid of a concentration between 70 to 83 per cent. H_2SO_4. The treated oil is then steam distilled in the presence of a fixed alkali, and finally decolourised by treatment with a comminuted solid adsorbent. Another application of the method is to treat petroleum oils with alkali and then acid, and subsequently to steam distill the treated oil in order to obtain a fraction of the desired boiling range. W. H. T.

566. Process for Removing Sulphur Compounds from Petroleum Oils. L. L. Odom. U.S.P. 1,604,235, Oct. 26th, 1926.

The process consists of passing petroleum vapours from a still through tightly packed and compressed copper wool, the fibres of which are of an even and extremely hair-like consistency. By this means the distillate is almost entirely freed of sulphur and sulphur compounds. W. H. T.

567. Process of Decolourising Petroleum Distillates. R. C. Pollock. U.S.P. 1,602,703. Oct. 12, 1926.

The process consists of treating gasoline or petroleum distillates with non-fuming acid and decolourising clay. The distillate is first treated with the requisite quantity of acid, and then, without removing the acid tar, the oil is treated with a predetermined quantity of refining earth. The acid and clay are allowed to settle, and the refined distillate is then drawn off. W. H. T.

568. Process for Decolourising and Stabilising Oils. P. W. Prutyman. U.S.P. Re. 16,439, Oct. 12th, 1926.

The invention describes a method of purifying and partly decolourising hydrocarbon oils. The oil to be treated is mixed with a powdered solid adsorbent, and heated in a closed vessel until a certain amount of decomposition of the oil takes place. The hot mixture is then steamed in order to remove the decomposition products, and finally, the spent adsorbent is removed from the oil by mechanical means. W. H. T.

569. Apparatus for Treating Cut Oil and the Like. C. C. Averill. U.S.P. 1,606,685, Nov. 9th, 1926.

The patent describes an apparatus for treating crude petroleum emulsions. The emulsion is taken from the well and allowed to flow to a tank, by way of a flow line adapted to serve as a conduit for both emulsion and petroleum gas. An elevated container is provided for holding a treating agent, and a feed pipe connects the lower end of the former to the flow line. The gases in the flow line are used to equalise the pressure in the upper part of the reagent tank. Thus, the treating agent will flow by gravity through the feed pipe into the flow line. An oil pipe is also provided which leads from the oil tank to the container so that oil can be mixed with the treating agent in the container. W. H. T.

570. Process for Treating Water in Oil Emulsions. M. de Groote. U.S.P. 1,606,698. Nov. 9th, 1926.

A process is described in which water in oil emulsions may be broken by admixture with a suitably chosen substance. According to the patent, this substance should be insoluble in water, but capable of being wetted with water. In addition, the emulsion breaker should be a colloidally dispersible substance free from fatty acid radical. W. H. T.

571. Process for Treating Petroleum Emulsions. Melvin de Groote and W. C. Adams. U.S.P. 1,596,595, Aug. 17th, 1926.

A process for breaking an oil emulsion by using an aromatic ester of an organic saponifiable acid as an emulsion breaker. Such esters may be prepared by the action of a phenol on a suitable acid, e.g., oleic acid in presence of phosphorus trioxde. K. B. R.

572. Process for Breaking Petroleum Emulsions. Melvin de Groote. U.S.P. 1,596,591. Aug. 17th, 1926.

In this process a water in oil emulsion is treated with any suitable emulsion breaker. When the emulsion has "started to break" fresh emulsion is added. The water coated films of this "breaking emulsion" wet the dry films holding the drops of water in the fresh emulsion and the water separates. The stage at which the emulsion starts to break is shown by the change of colour of the emulsion. K. B. R.

573. Process for Treating Petroleum Emulsions. Melvin de Groote. U.S.P. 1,596,589, Aug. 17th, 1926.

The author describes a method of treating water in oil emulsions with non-saponaceous substances such as the lactones, lactones, inner anhydrides of unsaturated fatty acids. These substances are prepared by allowing unsaturated acids to stand in contact with excess of sulphuric acid for 30 to 60 days. The demulsifying agents are usually mixed with a solution of a saponaceous substance, e.g., ammonium oleate to aid in bringing them into contact with the water droplets. K. B. R.

574. Process for Treating Petroleum Emulsions. Melvin de Groote. U.S.P. 1,596,593, Aug. 17th, 1926.

In this process demulsifying agents are used in what is described as a "pseudo nascent, highly colloidal, coagulescent suspension." This suspension is obtained by treating solutions of demulsifying agents such as sodium oleate with a solution of an inorganic salt, e.g., sodium chloride.

The author claims that a demulsifying agent in this state is very much more active than in aqueous solution. K. B. R.

575. Process for Treating Petroleum Emulsions. Melvin de Groote and W. C. Adams. U.S.P. 1,596,594, Aug. 17th, 1926.

This patent describes the use of a polycyclic aromatic hydrocarbon coupled with a sulphonic acid group and an organic fatty acid salt or ester as a demulsifying agent for use in breaking an oil in water emulsion. A typical example of such a compound is naphthalene sulphonaphthenate. K. B. R.

576. Process for Treating Water in Oil Emulsions. Melvin de Groote. U.S.P. 1,596,585 and 1,596,586, Aug. 17th, 1926.

A form of apparatus is described in which an oil emulsion is forced downward through a layer of non-absorbent material which holds the demulsifying agent in its interstices. Although these patents are considered to cover all non-absorbent substances, sand and finely divided zinc or iron are quoted as being the best substances to use.

Special apparatus is described for the introduction of the emulsion and removal of the oil. K. B. R.

577. Treatment of Water in Oil Emulsions. Melvin de Groote. U.S.P. 1,596,587, Aug. 17, 1926.

This process describes a method of breaking water in oil emulsions by mixing a non-saponaceous demulsifying agent with a substance which is capable of forming a water in oil emulsion in nearly equal proportions. The function of the latter substances is that of "carrier" to the former which is enabled to come into direct contact with the water droplets in the original oil.

The author states that a mixture of di-hydroxystearic acid and ammonium dihydroxystearate is twice as effective as the former alone and four times as effective as the latter alone for breaking certain water in oil emulsions. K. B. R.

Lubricating Oil and Wax.

578. The Non-Acidic Oxidation Products of Paraffin Wax. Francis and Gauntlett. *J.C.S.*, 1926, 316, 2377.

The majority of the work carried out hitherto on the oxidation of paraffin wax by air and oxygen, has dealt with the acidic materials formed during the oxidation. The present investigation concerns the very complex non-

acidic derivatives found among the products of air-oxidation of paraffin wax at 100° C. The authors have extended Grun's work (*Ber.*, 1920, **53**, 987) and proved the presence of secondary alcohols and ketones. It is also shown that di-hydroxy alcohols, hydroxy-ketones and diketones are probably present. Primary alcohols, if formed at all, must pass immediately to acids, since they are not present in the partly oxidised wax. The non-acidic products diminish in quantity with the increase of oxidation, and are replaced by corresponding acids. The authors have proved that the secondary alcohols and ketones which were isolated, have the same carbon content as six out of the seven normal hydrocarbons comprising the greater part of the paraffin wax. The ketones are derived from the secondary alcohols which are the primary products of the oxidation, and the point at which the carbon chain is attacked by oxygen was shown by an X-ray examination of these ketones, to be the third atom from the end. The ketones may break down on further oxidation, to acids of smaller carbon content. It is possible that alcohols and ketones may be oxidised to dihydric alcohols, hydroxy-ketones and diketones before the fully acidified stage is reached. Great difficulty was experienced in isolating pure compounds, but since it is now known that the paraffin wax under investigation is composed of a mixture of n-hydrocarbons, it is proposed to study the oxidation products of one of the suitable synthetic *n*-hydrocarbons. W. H. T.

579. Examination of Lubricating Oils (after use in Automobile Engines). P. V. Rosewarne. *Canad. Chem. Met.*, 1926, **10**, 233–236.

The changes in lubricating oils used in seventeen cars on the road were closely followed. It was found that the percentage dilution on use varied from ·5 per cent. to 20 per cent. The diluent was found to coincide closely in physical properties to the first 30 per cent. distillated from commercial kerosine. After removal of the diluent the residue was in general found to be more viscous than the original lubricating oil, this is thought to be due to oxidation. The carbon residue value of an oil was found to increase considerably with use. The lowering of flash point of an oil may be taken as a rough estimate of the percentage of diluent present in it. W. N. H.

580. Process of and Apparatus for Distilling Lubricating Oils from Mineral Oils. G. A. Kramer. E.P. 251,928. Aug. 19th, 1926.

Apparatus is described whereby petroleum may be distilled using steam and a partial vacuum in order to produce lubricating oils. The vapours from the still are passed to a heated condenser where lubricating oil vapours are condensed and separated from the uncondensed cracked products and steam. A seal is provided in the condenser which prevents any uncondensed vapours from passing from the condenser with the condensate. The uncondensed portion of the vapours is transferred to a second condenser where it is subjected to further cooling at a higher absolute pressure. A steam ejector is adapted to increase the absolute pressure of the uncondensed gases. W. H. T.

581. Process of Manufacturing a Non-emulsifiable Mineral Oil of High-dielectric Strength. H. T. Maitland. U.S.P. 1,605,046. Nov. 2nd, 1926.

In this process the crude petroleum is distilled until a solid residue is left in the still. The lubricating oil fractions are treated with an alkaline solution in an agitator at 80° F.—160° F. After agitation for 1 hour the oil is allowed to stand and the soaps drawn off from the bottom. This treatment removes

organic acidity. The oil is then washed with water and steam, followed by a sulphuric acid wash at 60—75° F. Agitation is brought about by jets of compressed air. The oil is once more given an alkali wash followed by water and steam to remove excess alkali. The oil is then distilled in the presence of a little absorbent matter, *e.g.*, fullers earth. If preferred the oil may be distilled before the acid treatment. In this case after washing the alkali out following acid treatment, the oil is heated to 110—120° F. and blown with air to remove the last traces of moisture. K. B. R.

582. Process of Refining Mineral Lubricating Oils. J. W. Wier. U.S.P. 1,603,174. Oct. 12th, 1926.

The invention consists of a method of refining lubricating oil in which the oil is treated with sulphuric acid, and the major portion of the sludge removed by settling. The treated oil is then agitated with a powdered adsorbent at a temperature below that at which the sludge decomposes. The solid sludge thus formed is removed from the oil, and the latter is again treated with solid adsorbent, but at a sufficiently elevated temperature to decompose the residual sludge, and liberate sulphur dioxide. During heating, the oil is blown with a non-oxidising gas. Subsequent removal of the solid adsorbent completes the refining process. W. H. T.

Cracking and Hydrogenating.

583. Handling Pressure Tar. E. E. Barbels and E. I. Shaeffer. U.S.P. 1,594,038.

The difficulties encountered in redistillation of tar from pressure cracking processes, due to sediment—the excessive formation of coke, are overcome by using a system of settling tanks, distilling the settled oil and mixing the sediment with high gravity (at least 1·00 at 60° F.) oil. The mixture can be used as a fuel which does not deposit the sediment. R. P.

584. Oil Treating Apparatus. E. A. Dieterle. U.S.P. 1,589,631.

A metallic shell is provided with a combustion chamber at one end and a smoke stack at the other end. Metallic tubes or flues, bent back and forth within the shell, connect the combustion chamber and stack. Vapour and residue outlets are provided at top and bottom of the shell.

The treatment is accomplished by spraying oil into contact with the heated surfaces of the flues which are so arranged that the oil is progressively heated as it flows downward. It is claimed that there is only a small amount of oil in the cracking system, thus reducing the danger of operation, whilst the formation of carbon is less likely and can be readily removed. R. P.

585. Improvements in or Relating to the Distillation or Cracking of Tars, Petroleum Oils and Similar Materials. C. R. Downs. E.P. 258,433, 1925.

Oils and tars or their distillates may be distilled to avoid cracking or alternatively to promote cracking, by using the latent heat of condensation of sulphur vapours as the supply of heat. By increasing or decreasing the pressure upon the heated sulphur, the boiling point of the latter may be varied to suit requirements and substantial overheating of pipes and stills is thereby avoided. H. G. S.

586. Process for Treating Hydrocarbons. C. P. Dubbs. U.S.P. 1,600,721, 1926. Appl. Jan. 12th, 1920.

The cracking of heavy oils is performed as follows. The raw material is pumped through a plurality of pipes erected in a vertical position in a furnace and then enters a vapour chamber external to the furnace. The heavy residue deposited in the chamber is withdrawn continuously whilst the vapours enter the lower portion of a dephlegmator. Here they encounter fresh stock entering the system in such a way that the raw oil is preheated and the cracked vapours partially condensed. The uncondensed vapours pass through condensers to storage, whilst the mixture of preheated raw oil and condensed vapours flows from the bottom of the dephlegmator to the cracking tubes. H. G. S.

587. Process and Apparatus for Cracking Hydrocarbon Oils. W. F. Faragher, W. A. Gruse, and F. H. Garner. (*a*) U.S.P. 1,601,727–8, 1926. (*b*) U.S.P. 1,601,730, 1926. Appl. (*a*) Jan. 15, 1921; (*b*) March 29th, 1923.

(*a*) Pressure stills used for cracking oils are provided with a number of vertically arranged baffles, so disposed that the oil can circulate both above and below them. Towards the bottom of each alternate pair of baffles is introduced a continuous stream of gas which induces a rapid circulation of the oil and prevents the necessity for using a mechanical stirring device. Deposition of carbon by local overheating of the oil at the bottom of the still is avoided.

(*b*) Longitudinal in place of vertical baffles may be used. H. G. S.

588. Improvements Relating to the Cracking of Oils. G. E. Heyl. U.S.P. 259,493.

The process involves the resubjection to a cracking temperature of the oil until the entire bulk has been decomposed into gas, oil and carbon. A plurality of chambers, each maintained at from 600° to 1000° C. and each delivering vapour into separate dephlegmators, are disposed in series. The condensate in the fractionating columns passes into the next cracking chamber. The oil is thus repeatedly subjected to cracking temperature. To collect the major portion of the carbon and reduce the amount deposited on the walls of the stills, the oil is delivered into a removable trough which is spaced from the walls of the still. This liner is periodically freed from carbon. R. P.

589. Process of Distilling Petroleum. S. O. Hicks. U.S.P., Re. 16,443.

The apparatus consists of a still with an air-cooled condenser situated above it. Within the still a trough is suspended in the vapour space, to catch any condensate from the air-cooled condenser. The reflux oil is cracked and revapourised in this trough. The apparatus is worked under a pressure of four to five atmospheres. It is claimed that by this method, the mixing of condensed vapour with the bulk of the oil is prevented and does not destroy its viscosity. The oil in the still is not cooled by the returning reflux oil, but is kept at its high temperature and distilled in the minimum period of time. R. P.

590. Means and Method for Removing Deposited Material from Cracking Apparatus. L. C. Huff. U.S.P. 1,603,541.

This method has been devised to break up a solid carbon mass, such as is produced by cracking heavy fuel oils, and consists of injecting steam or

water into the body of carbon, whilst in a heated state, within a still or reaction vessel.

A number of tubes of different length are fitted within the reaction vessel and connected to a manifold outside. Conical plugs are inserted into the open ends of the tubes to prevent coke forming inside and choking the tubes. When the apparatus is shut down for cleaning, the reaction vessel is opened and steam or water is pumped through the tubes. As soon as pressure is applied the conical plugs are blown from the ends of the tubes and the fluid enters the coke mass. The heat of the carbon expands the fluid and breaks up the coke, which can then be readily removed. R. P.

591. Process of Making Low-Boiling Hydrocarbons from Petroleum or Other Oils. J. H. James. U.S.P. (*a*) 1,597,796, 1926; (*b*) 1,597,798, 1926. Appl. (*a*) Nov. 13th, 1919; (*b*) July 21st, 1922.

The first stage in the conversion of heavy into light hydrocarbons consists in passing them in the state of vapour, with or without steam, and with air in carefully regulated proportions over catalysts such as the oxides of molybdenum, vanadium or uranium maintained below a red heat. The product consists of partially oxidised substances from alcohols, through aldehydes to aldehyde acids. This product is then thermally decomposed in the vapour phase by passage over contact substances like iron, nickel or copper and/or basic oxides like magnesium oxide, steam being used in conjunction with the "oxidised oil" vapours. The temperatures employed in the second stage exceed 450° C. The motor-spirit produced contains a certain proportion of oxygenated bodies which resist knocking. H. G. S.

592. Process and Apparatus for Obtaining Light Hydrocarbons and Carbon from Heavy Hydrocarbons, Coal Tar, Pitch and the Like. W. Knapp and Wandsbeker, Masch. und Eisenbauanstalt, Fischer and Steiding. E.P. 257,152, 1925.

The apparatus is designed to convert heavy oil, tars, pitch and the like into chemically pure carbon and gas or alternatively into carbon, gas and light hydrocarbons. A number of cylindrical, horizontal tube-stills, heated to bright redness, are closed at one end with a door and are provided at the other with a pipe which leads to a common still completely enclosed in insulating material. The tubes from the pipe-stills terminate a short distance above the bottom of the insulated still, the latter being maintained about half full of oil or tar and provided with a vapour outlet pipe leading to coolers, condensers and gasometer. The material to be treated is placed in cylindrical containers fitted with a suitable lid, the whole being pushed on guides into the hot tube-stills. The material quickly boils, raises the lid of the container and overflows on to the heated walls, where carbon is deposited. The vapours pass into the body of oil, heating and gasifying it in their passage and are ultimately cooled and compressed to recover liquefiable hydrocarbons. H. G. S.

593. Conversion of Heavy Hydrocarbon Oils into Light Hydrocarbon Oils or Spirits. F. Lamplough and Ratoczyn Extended Oilfields, Ltd. E.P. 258,656, 1925.

The oil to be converted is mixed with an aromatic hydrocarbon, *e.g.*, naphthalene, and pumped at high pressure through two heated coils, the latter of which has the greater capacity. A specially designed valve is described, which operates intermittently so that, at regulated intervals, the oil which has remained quiescent for some time in the larger coil is allowed

to escape rapidly to a cooler, thereby carrying with it the solid, liquid and gaseous products. The temperature of the cooler is held so that the required gasoline is distilled off. H. G. S.

594. Process of Treating Hydrocarbons. H. I. Lea and C. W. Humphrey. U.S.P. 1,606,246, 1926. Appl. May 26, 1922.

The process consists in treating heavy oil vapours with aluminium chloride prepared *in situ*, and may be modified to produce mainly oil-gas or low-boiling hydrocarbons. The oil to be treated is distilled in a current of chlorine, the mixture of gases being led into a retort containing alumina which is fed in from time to time to maintain an excess of the oxide.

The products of reaction, *viz.*, aluminium chloride, carbon monoxide and hydrocarbons then enter a digestor which is provided with a heavy residue draw-off and a vapour line leading to condensers. The contents of the digestor are maintained at a lower temperature than that existing in the retort. Substantial desulphurisation of the products is also claimed whilst alternative types of apparatus are described.

Large gas make is facilitated by the use of larger quantities of chlorine than are required if spirit is the desired product. H. G. S.

595. Production of Lower-Boiling Distillates from Higher-Boiling Petroleum Hydrocarbons. A. M. McAfee. U.S.P. 1,601,636, 1926. Appl. April 25th, 1925.

Heavy hydrocarbon oils are distilled in the presence of not more than 3 per cent. of anhydrous aluminium chloride and the vapours removed as quickly as they are produced, *i.e.*, without any attempts at refluxing. H. G. S.

596. Process of Recovering Light Oils from Residual Products. A. Oberle. U.S.P. 1,599,429, 1926. Appl. April 14th, 1924.

Tarry residues, sludges, petroleum carbons, etc., are subjected to distillation under pressure, preferably with use of steam, the vapours being delivered into the bottom of a similarly heated pressure still which is filled with petroleum coke or highly absorbent charcoal. The latter removes the tarry substances from the light vapours, the latter only emerging and being taken through condensers to storage. The process may be batch or continuous. H. G. S.

597. Process for Converting Hydrocarbons. R. T. Pollock. U.S.P. 1,602,990, 1926. Appl. Nov. 25, 1919.

A plant for the cracking of heavy distillates consists of a series of tubes arranged in a furnace, a vapour chamber provided with a residue draw-off and a vapour line, a dephlegmator, condensors and pumps. A portion of the ingoing oil is by-passed through the dephlegmator, whereby it becomes preheated and mixes with the condensate, the arrangement of valves being such that the proportion of raw oil to condensate can be controlled. H. G. S.

598. Apparatus for Cracking Oil. G. L. Prichard. U.S.P. 1,605,063.

The apparatus consists of a vertical steel still, bottom heated, and working under pressure. A vertical shaft passes through oil cooled bearings and stuffing boxes on the top of the still and at a distance from the bottom an angle iron bracket supports a thrust collar on the shaft. The bottom of the shaft carries crossbars, to which scraping chains are connected. The steady movement of the scraper on the bottom of the still removes carbon from the heated zone as it develops and keeps it circulating through the body of the oil. R. P.

599. Manufacture of a Fuel for Internal Combustion Engines. J. D. Riedel Aktiengesellschaft. E.P. 246,182, 1926.

Tetrahydronaphthalene is heated in excess of 400° C. in presence of alumina or a mixture of alumina and one or more other metallic oxides, if necessary in presence of hydrogen, whereby partial cracking occurs. Similar results are obtained with naphthalene provided an abundant supply of hydrogen is present. The cracked product is distilled to 200° C. to give a motor-spirit. H. G. S.

600. Heating Liquids by Introduction into Molten Metal. T. Rider and J. S. Watts. U.S.P. 1,600,139, 1926. Appl. Feb. 28, 1924.

Reference is directed to U.S.P. 1,527,847 on which this is an improvement, designed to cause the pellets of solid metal thrown up from the surface of the molten metal to fall back in a regulated manner and ultimately sink and re-melt. H. G. S.

601. Process for Refining Petroleum and Other Materials. W. A. Schmidt. U.S.P. 1,604,424.

This process for cracking or distilling oil consists of spraying hot oil at a suitable temperature into a vertical still through which suitably heated gases are travelling. The outlet pipe from the still communicates with an electric precipitator, comprising a vertical tube with inlet and outlet chambers and an insulated conductor placed centrally. Leaving the separator the vapour passes into a vertical cooler, wherein it is mixed with a proportion of cooling gas, which forms a fog of suspended particles of oil. Alternate electrical precipitation and cooling follows and finally the gas returns for repetition of the process, either as a heating or as a cooling medium. R. P.

602. Process for Treating Hydrocarbon Oils. J. B. Weaver. U.S.P. 1,601,786, 1926. Appl. June 15, 1925.

The cracking of oils substantially in the vapour phase and in presence of steam and a metallic-oxide contact agent is carried out somewhat as follows. The oil is heated in a pipe still under pressure, *e.g.*, 25 lb. per square inch and is then suddenly expanded into a large vessel. The vapours so produced are passed into a converter, whilst the heavy ends fall to the bottom of the expander and are withdrawn. The vapours, immediately before entering the converter, are mixed with steam under pressure and then caused to traverse a series of pipes which contain, *e.g.*, ferric oxide heated to about 593° C. (1100° F.). Leaving the converter the vapours and steam now enter a tar-leg in which they are rapidly cooled to about 230° C. by fresh cracking stock introduced through a jet. The carbonaceous matter deposited settles to the bottom of the tar-leg whilst uncondensed vapours pass through a fractionating column and condensers, the reflux from the tower being conveyed back to the pipe still. The tarry liquor in the tar-leg is removed periodically. H. G. S.

603. Treating Hydrocarbon Oils. E. R. Wolcott. U.S.P. 1,601,421, 1926. Appl. Oct. 1st, 1924.

Heavy oils are cracked by distillation in presence of aluminium chloride in a series of vessels which are alternately cooling and heating stills. The oil is admitted into still No. 1, and there mixed, whilst cold, with the requisite amount of aluminium chloride. It then flows into still No. 2, where it is distilled, the vapours being taken off through a condenser. The residual oil next enters still No. 3, where it is cooled, mixed with a further charge of aluminium chloride and then distilled in still No. 4. This operation may be repeated in successive pairs of stills. H. G. S.

604. Process for the Continuous Production of Low-Boiling-Point Hydrocarbons from Hydrocarbons having a High-Boiling-Point. H. Wolf. E.P. 252,308, 1925.

Heavy oils to be cracked are heated under pressure in coils and then caused to expand in contact with a heavy wash oil, which removes the asphaltic and other bodies and prevents the deposition of carbon on the walls of the plant. Means are provided whereby the incoming oil is pre-heated by the outgoing oil and vapours, the refluxed condensate from a dephlegmator is returned to the cracking stock tank and the wash oil is withdrawn and returned to the circuit as long as it is efficient. Alternatively, the whole of the cracked products may be condensed in the wash oil, the mixture being then distilled to recover the benzine. H. G. S.

605. Apparatus for Hydrogenating Oils. E. L. Anderson. U.S.P. 1,599,629, 1926. Appl. March 26th, 1923.

A mixture of heavy hydrocarbon oil and water is fed under pressure into a horizontal, cylindrical vessel which is maintained about one-third full of liquid. The vessel is fitted with a rotating shaft supplied with a number of disc-like elements which are partially immersed in the liquid. The discs are composed of spirally arranged nichrome wire and are heated by means of a current to a temperature of 600°–800° F. (315–425° C.). Under the influence of the temperature and catalytic properties of the heating elements, the oil is partially cracked and the water partly vaporised and partly decomposed into its elements. The hydrogen liberated reacts with the cracked oil vapours, whilst the oxygen unites with deposited carbon. The resulting vapours then pass through an insulated, vertical stand-pipe fitted with another set of heating elements. The products are then condensed.
H. G. S.

606. Improvements in the Process of Hydrogenating Tar Oils. W. Demann. E.P. 236,230, 1925.

The hydrogenation of tar oil is effected by means of coke-oven gas. The oil is first desulphurised, *e.g.*, by heating to 150–200° C. with ferrous sulphate or bog-iron ore. Coke-oven gas, dried preferably with sulphuric acid, is then passed through the purified tar oil, to which has been added a nickel catalyst reduced at 310° C., the temperature of the mass being maintained at from 180–200° C. Finally, the product is distilled with steam at about 175° C. The residue is highly viscous. H. G. S.

607. Splitting up of Tars, Crude Mineral Oils and the Like. M. Melamid. U.S.P. 1,602,310, 1926. Appl. July 5th, 1923.

Crude tars, mineral oils, etc., are sprayed by means of hydrogen, or other gases which prevent dehydrogenation into a mass of metal which is molten at the temperature of reaction. The metal must be such as not easily to form carbides so that lead and zinc must be excluded; tin, antimony and bismuth or their alloys are suggested. The deposition of pitch or coke is inhibited. Heavy phenols are converted partially to hydrocarbons and partially to cresols and lower boiling oxygen compounds. The reaction gases, if free from oxygen, may be used instead of hydrogen. H. G. S.

608. Hydrogenation and Production of Non-Sludging Oils. H. R. Moody. U.S.P. 1,601,406, 1926. Appl. May 28th, 1923.

The oil which is to be rendered non-sludging is maintained in intimate contact for some time, and at a temperature of 120–150° with a mixture of aluminium carbide or "other carbide forming hydrogen with the salt,"

at an appropriate temperature for the reaction. Prior to hydrogenation, the oil may be purified by heating with, *e.g.*, bone charcoal, fullers earth, ferric oxide or mixtures thereof. A suitable hydrogenating mixture is five parts each of aluminium chloride and aluminium carbide to 100 parts of oil.

H. G. S.

Geological and Fields.

609. The Fergana Oil Region. A. Pritula. *Petroleum Times*, pp. 841–842, 929–930, and 975–977.

The Fergana oilfields are located in the Fergana region which is now within the Uzbek Soviet Socialist Republic. Although the Fergana region is bordered by China on one side and by Afghanistan on the other, and is in the immediate proximity to India, the boundaries separating the region from these countries extend along the almost impassable mountain ranges of Pamir which border the Fergana depression on the south. The depression measures 250 by 100 kilometres and is surrounded by high mountain ranges. On the north and east it is bordered by the Chatkal and Fergana ridges, on the south it is confined by the Altai mountain range. On the south west, the region is separated from Eastern Bukhara and the Samarkand region by the Turkestan range. The oilfields are located on the edges of the Fergana depression, on the foothills of the Altai range, as well as of the Fergana range. The fields may be divided into three groups, each comprising several fields. The first (southern) group includes six fields, Tash-Ravat, Sel-Rokho, Shur-Su, Kamysh-Bashi, Rishtan, and Chimion. The northern group consists of five fields: Maili-Sai, Piteu-Sai, Encunim-Sai, Shing-Sai, and Kulmen. None of these fields have yet been developed. The eastern group comprises two fields: Changyr-Tash, and Tekebel. Of the above oilfields, only two are producing oil on a commercial scale, *namely*, the Sel-Rokho and Chimion. The oil-bearing strata of Fergana consist mainly of tertiary strata, *namely*, Oligocene and Eocene. The upper part is characterised by its red colour, due to ferric oxide compounds, while the lower part is coloured green with ferrous compounds. The green formation is known as the Fergana stage, and contains oil-bearing horizons.

The Chimion Oilfield.—This field comprises two pools—the Chimion oil pool proper, and the Yarkutan pool. Within the Yarkutan area, the beds of the Fergana stage form an anticline which is so compressed from both sides, that its flanks are nearly vertical. The fold is overturned alternatively toward either side. The geological structure of the eastern or Chimion area proper is on the whole similar to that of the Yarkutan area. The Chimion fold extends from E.N.E. to W.S.W., its axis plunging in either direction. The fold is complicated by a strike fault, cutting it approximately along the axial plane, owing to which the southern flank of the fold is somewhat pushed over the northern one. The fault plain dips south at an angle of approximately 80°. The oil-bearing strata of the Chimion oilfield belong exclusively to the Eocene formation. The green clays overlying limestone "m" are interbedded with petroliferous sands which are being exploited within the Yarkutan area. In the Chimion field, oil is extracted mainly from sands overlain by limestone "m." The green clays underlying the petroliferous sand do not carry oil within the area under consideration. The oil-bearing formation is overlain by the Oligocene green clays, by the horizon "n," and by the strata underlying the latter. It is underlain by the gypseous formation of Cretaceous age, which has been shown to contain no indication of oil. The specific gravities of Chimion oil and Yarkutan oil are respectively ·866 and ·888. The mixed crudes contain 4·92—9·05 per cent. of benzine, 22·75—29·95 per cent. of kerosene, and 71·61 per cent.

of fuel oil. The fuel oil forms a good basis for the manufacture of lubricating oils. The Chimion oilfields are equipped both for drilling and oil production and have all the necessary auxiliary plants, mechanical shops, water system, etc. The daily capacity of the refinery is about 410 tons, but as the refinery capacity greatly exceeds the production of the field, the plant is operated intermittently twice or three times a year.

The Sel-Rokho Oilfield.—This field lies in the Kokland district of the Fergana region. The main structural feature is an anticline trending in almost latitudinal direction and made up of Tertiary and Cretaceous rocks. In the crest of the anticline, strata of the Cretaceous gypsiferous formation are exposed. The northern flank of the anticline dips northward at an angle of 25°, and passes westward into a monocline. To this main Sel-Rokho anticline, a wide and flattened syncline composed of rocks of the Fergana stage joins from the south. The syncline is adjoined on the south by another short anticline resembling an eroded dome. In the crest of the latter there are exposed not only Cretaceous sediments, but also dark Palæozoic shales, the axis trending S.W.–N.E. and plunging north-eastward. Four horizons of the Eocene have been proved to be of commercial importance. The first (upper) horizon is composed of limestone, and the rocks immediately overlying and underlying the same. The second is of sand, included in the formation of the green clays, and interbedded with layers of Gryphæa shells below the limestone. The third horizon lies between two deeper limestones and is represented by a layer made up of oyster shells underlaid by marl. The fourth horizon, in the middle of the limestone comprises three separate pools—western, eastern, and central. The oil yielded by the first horizon has a specific gravity of ·845—·850, a benzine content of 30 per cent. and a paraffin content of 6 per cent. The second horizon yields a heavier oil of ·868—·875 specific gravity. The benzine content is 15 per cent., while there is an appreciable percentage of wax present in the oil. The oil from the third horizon has a specific gravity of ·890—·900, and contains little gas, no benzine, and no wax. The fourth horizon yields the heaviest oil, the specific gravity being ·920—·940. The average yield of products from the mixed crudes is:—benzine 5—6 per cent., kerosene 19 per cent., and fuel oil 75—76 per cent. W. H. T.

610. The Oukhta Oil-Bearing Region. By S. Obruchev. *Petr. Times*, Oct., 1926. Pp. 655–658 and 785–788.

The Oukhta oilfield is situated in Russia on the southern extremity of the Simon Mountain Range within the autonomous region of Komi, and extends from 62°·45′ to 64° north latitude and from 22° to 24° east longitude. The Oukhta region is composed of the following rocks in the order of their age:—

1. The Sericite Schists of Pre-Cambrian age, over 450 metres thick.
2. The Upper Devonian Rocks:—
   - (*a*) Sub-Domanik oil-bearing formation consisting of alternating blue, grey and red-brown marls, clays and partly sandstones with a total thickness of 250 metres. The formation includes three oil-bearing horizons.
   - (*b*) Domanik formation of calcareous and argillaceous bituminous shale with an abundant cephalopod fauna; thickness 75 metres.
   - (*c*) Over-Domanik formation—blue marls with layers of micaceous sandstones and argillaceous limestones; thickness 120 metres.
   - (*d*) 210 metres thickness of marls, sandstones, limestones and dolomites with Sp. Anossofi (Mid. Devonian).
   - (*e*) Gypsiferous formation of 40 metres thickness.
   - (*f*) Limestones, marls and clays with Rhynchonella livonica; 90 metres.

3. Carboniferous rocks; these rest on the eroded surface of the Devonian, and are composed of limestones and marls.

4. Permian varicoloured marls.

5. Mesozoic clays (Volga stage and Cretaceous).

6. Post-Tertiary deposits (ancient alluvium and boreal transgression).

The rocks of the Oukhta region are folded into an anticline with gently dipping flanks, trending north-north-west, and gradually plunging northward and southward. The fold is thus a very flattened elliptical dome, in the middle of which the rocks of the petroliferous series crop out, while the other above-cited formations are exposed in concentric belts closing with the Permian on the west and the Mesozoic on the east. Strata dip at angles varying from 2° to 4°. The second structural axis of the Southern Timan lies in the western portion of the latter, in the region of the old Sericite Schists. The Devonian series rises slightly towards the latter, but the schists are isolated from the Devonian by a fault striking in the same prevalent north-north-westerly direction. It is believed that within the Palæozoic there are, besides the one mentioned, still some other faults of the same direction.

The oil-bearing horizons are of Upper Devonian age, and consist as a rule of the following horizons beginning with the lowest:—

1. On the Sericite Schists lie bituminous grey sandstones, the uppermost of the latter represent the second more prolific oil-bearing strata of the region.

2. Blue clays, marls and shales.

3. Brown-red marls.

4. Greenish-blue and grey marls, clays and shales. Within these strata lies the first oil-bearing horizon, which is poorer than the one mentioned above.

The oil horizons are saturated very feebly; the first yields not more than 50 kilograms per day, the second yielded during two months 300 kilograms daily, while the third gave from 150 to 650 kilograms. According to Nalivkin, the oil-bearing series consists of lagoon, bay and possibly delta deposits. Such basins are most favourable places for the accumulation of organic matter and the formation of petroleum. The latter is thus of primary origin.

In the main, the oil obtained from the Oukhta region is thick and dark brown, and varies somewhat from well to well. The following is an analysis of a typical sample:—

Specific gravity, ·8832 at 17·5° C.
Viscosity at 20° C. (compared with water at 20° C.), $E_{20}=9$.
Flash point, 21° C.

A distillation of the oil gave the following products:—

Fractions.	Specific Gravity.	Yield.
28° to 150° C.	— ..	12·0%
to 200° C...	— ..	9·2%
200° to 250° C...	·820 ..	7·3%
250° to 270° C...	·832 ..	13·4%
270° to 300° C...	·815 ..	5·6%
Residue	·957 ..	50·0%

The residue was a thick viscous fluid of a highly asphaltic nature, and contained a quantity of wax equivalent to 0·5 per cent. on the crude. The gas which is produced with the oil is stated to consist mainly of methane (99·2%). W. H. T.

611. The Rosecrans Oilfield of California. E. H. Musser. *Petr. Times*, 1926, **15**, 871–872.

This field is 10 miles south of Los Angeles, and consists of three separate structures within an area two miles by one-third mile. The northern area is known as the "Athens Area," the other part being divided into the "Central Area" and the "Main Street Area."

The presence of gas and oil in shallow water wells was known for a long time before the first well was started on October 20th, 1919. Shows of oil in this well were tested, but no commercial production was obtained, and it was abandoned at 3252 ft. in June, 1920. The second well, which was commenced in June, 1920, was abandoned at 2850 ft. in August, 1921. The next well started was the Porter No. 1, which was suspended at a depth of 4520 ft. This well was subsequently continued, and, at a depth of 4971 ft., 1000 barrels per day of 37° oil obtained. A number of other wells have obtained oil from the 4900 ft. zone and another productive sand has been found at about 4200–4350 ft. G. S.

612. The "Neftedag" Oil Deposit. S. A. Kovalevsky and N. Kornev. *The Azerbaidjan Oil Industry*. Feb., 1926. No. 2, p. 27.

This deposit may be divided into two parts:—(1) Apsheronskaya, wholly situated at the foot of Neftianoi Hill and disclosing itself mainly in the Kolsevoi valley, appearing as a series of oil-bearing layers similar in age to the Apsheron strata. (2) The second deposit, stratigraphically deeper, does not disclose itself anywhere, but by analogy with Cheleken it can be stated that it belongs to the horizon of oil layers forming the foot of the Akchagilsky stratification. It is, therefore, called the Sub-Akchagilsky deposit. The Sub-Akchagilsky deposit should be developed from the ridge of the folds, whence, according to the declination of the strata, it may extend to one side of Kolsevoi valley under the first oil deposits of the Apsheron bed.

Both these deposits are limited to the northern half of Neftianoi Hill, the area having the form of a segment the chord being 1875 sag. long with a width of 750 sag. and containing about 300 desiatines.

A strip ½ verst wide along the arc gives a little over 200 desiatines for the upper Apsheron deposit, while for the Sub-Akchagilsky deposit a semi-circular area with a radius 300 sag. give a surface of 60 desiatines.

The possible value of the productivity of this area may be judged from drilling data and hand dug wells.

It can practically be concluded, for the Apsheron layers, that:—

(1) The oil-bearing zone can be gauged at some tens of sagenes; included in which are rows of oil sands, which even at a depth of 15–20 sag. yield about 30 poods, quickly increasing up to 300–600 poods at the depth of 50–70 sag.

(2) Deeper in the wells between the individual oil sands, no water is observable. Therefore the possibility of exploiting the total number of producing layers in each well, by means of perforated casing, is great.

(3) All wells drilled and hand dug indicate gaseous oil. The latter is a valuable sign denoting the presence of a sufficiently high gas factor in the bed.

(4) The absence of fountains from the first wells denote that the general degree of saturation is not great and therefore the production should not decrease as rapidly as in fountain areas. T. W.

613. Removing Water from Gas Wells for Protection of the Field. C. H. Lutz. *Oil and Gas J.*, 1926, **25** (22), 77, 108, 111.

Where a well can be shut in casing under light water conditions with sufficient pocket to allow of bailing not more than three times a year, operation as bailing wells is the most economical. When tested with 2-inch tubing, with light water conditions, blowing the water through a syphon pipe by well or line pressure is adequate. In low or high pressure wells, under heavy water conditions, the most suitable means of removing water is by pump and power outfits.

When shutting-off water below the gas sand, the use of a plug is preferable to a packer. Clay and stones are dropped in the well to form a seat for a pine plug of the hole and mandril type, which is lowered on the tools. When in position, the mandril is driven into the plug, which is thus expanded. If space permits, more stones and clay are dropped in and a lead plug inserted and drilled on for at least one hour. In cases where wells are to be abandoned, a similar procedure is adopted, but special precautions must be exercised to ensure that the water cannot reach the gas sand and, by permeating this, so ruin the whole field. G. S.

614. Redressing and Welding Oilfield Tools. *Petr. Times*, 1926, **15**, 847–868.

A welding medium attracting much attention is flint alloy, which has elements resisting abrasion to a high degree. Some manufacturers are using this for the cutting edges of bits, to which it can be applied by the acetylene torch or the electric arc. It can also be recovered from a damaged tool by melting off with an acetylene torch.

For welding, a low-temperature reducing flame is necessary, the article to be welded being pre-heated to a bright red. Two types of weld are in general use, either flint alloy welded to steel or cast-iron, or two pieces of flint alloy welded together. G. S.

615. The Diameter of "Beans" for Fountain Wells. I. Strigeoff. *The Mining Journal*. Sept., 1925. No. 9, p. 761.

The measures for extracting fountain oil from the wells with a longer lasting action of the fountain, and a fuller extraction of oil from the strata are :—(1) A rational position of wells drilled on a fountain deposit ; (2) A rational diameter for the wells ; (3) Capping fountains ; (4) The erection of syphons ; (5) The erection of "beans" ; (6) The regulation of fountain oil pressure. Wells should not be drilled close together on a fountain deposit and should be capped with a casing head, with the syphon tubes passing through it. The "bean" is placed at the end of these tubes with the necessary valves.

In Grosny this method has been applied for a long time and all fountain wells are capped.

The Californian practice of using smaller diameter beans and placing them at the lower end of the tubing in the well and not at the top, and leading both oil and gas through an hermetically sealed trap, should be carried out here. In the majority of wells it has been proved that placing the bean at the bottom of the well has resulted in a greater production of oil, the diameter of the hole varying from $\frac{1}{4}$ inch to $\frac{3}{4}$ inch.

The question of this diameter is very important and there are grounds for believing that for Baku a diameter of more than $\frac{1}{4}$ inch. is not fully rational. Would it not be better to commence with $\frac{1}{4}$ inch diameter and gradually increase it ?

Wells exploiting the XI. horizon at Soliony-Balka in Grosny and the XIII. horizon in the New-Grosny district are not near to each other on these fountain areas, are capped, the issue of oil from the well is controlled and the strata retains a great pressure. By this means wells have been maintained with a fountain lasting eight years. This is possible only if extensive drilling is not carried on. On such areas, the wells are not placed near to each other, and the beans do not have an extra large diameter hole. T. W.

616. Some Analytical Principles in Recovery by Force Drive. S. C. Herold. *Oil and Gas J.* Oct. 28th, 1926.

In this article the author discusses the theory of the application of forced drive to exhausted wells. It is assumed for the purpose of the discussion that the productive formation is horizontal, of uniform thickness, and of homogenous texture. Furthermore, the reservoir contains oil with gas in solution, some of the gas being in the free state, and spread evenly in the form of minute bubbles within the pores of the formation. The application or release of pressure on these bubbles causes certain effects which have been described by Jamin (*Oil and Gas J.*, Feb. 19th, 1925). In an undeveloped field, the oil is held in place by the compressed gas and cannot move until the pressure is relieved by the drilling of a well. In any single well, the drainage radius depends on the capilliary action, and therefore the drainage is not co-extensive with the limits of the reservoir. Ideal conditions therefore provide a drainage area which is a perfect circle. Now, if normal production conditions be reversed, and a fluid be pumped into the well, the internal pressure becomes greater, the gas bubbles contract in volume, and eventually a pressure is attained, which is equal to the original pressure of the reservoir. On increasing the pressure still more, static conditions are overcome, and the oil commences to move.

It is necessary now to postulate two exhausted wells, one receiving fluid under pressure, and the other equipped with some means of raising oil so that there is no head of oil to counteract the flow from the first well. On increasing the pressure in the first well, the effective circle of oil movement will eventually include and pass beyond the second well. All fluid within this greater area is under stress, but only such fluid as may lie within a restricted portion of the circle may move. This area extends between the two wells and is of such a shape that lines drawn from the wells to any and all points on its periphery have a sum equal to the original drainage radius R_1. As the pressure is now maintained at a constant value P_1 there is a radius of action equal to R_1 defined and fixed in length and confined to those directions whereby it may succeed in moving oil towards the second well W_2. Thus, with regard to this area it can be said that for all points c,

$$W_1c + W_2c = R_1.$$

It is known that the elipse is the curve which satisfies this equation, and that the sum of the focal radii of the elipse is a constant. The wells then are located at the foci of an eliptical area. The increase of the elipse in area will be limited by the capacity of the plant furnishing the fluid under pressure, and by the presence of other open wells in the vicinity. The lineal velocity of the fluids along all focal radii is constant; consequently the eliptical area under the ideal conditions is completely swept clean of valuable fluid at the instant when the driving fluid arrives at W_2 simultaneously from all directions. Actual operations of flooding oilfields involve numbers of elipses extending from well to well, but all the oil is not recovered unless the elipses completely cover the area. In order to apply this theory of elipses to actual practice it is necessary to devise a method of determining

the actual dimensions of the elipses in any particular case. This can be done as follows :—Assume that the equation expressing the relation between the pressure applied, and the radius of action is

$$P = KR^2 \text{ or } \frac{P'}{P''} = \left(\frac{R'}{R''}\right)^2$$

where P′ = the pressure at well W_1 during process of driving

P″ = the pressure at well W_1 corresponding to the distance between well W_1 and well W_2

R′ = sum of the focal radii of the elipse.

The values of P′ and R′ will be evident, while P″ will require an observation at W_1, which may be made as follows :—Apply pressure at W_1 until flow starts at W_2, exceed this pressure slightly and close W_1 so that the pressure will not fall. Now draw off fluid at W_2 so long as it comes to the well, and observe the final reading of the gauge at W_1. This is P″.

The value of R′ may now be calculated. Let one half of R′ be equal to "a," this being one half of the major axis of the elipse in the usual mathematical notation. At one point "e" on the periphery, the two focal radii m and n are equal or,

$$m + n = R'$$

and $W_1e = m = n = \frac{1}{2} R' = a$.

Now let the minor axis of the elipse be designated by "b" then,

$$b^2 = a^2 - \left(\frac{R''}{2}\right)^2$$

according to the right angle with sides m = a, b, and $\frac{R''}{2}$

From this equation the value of "b" may be calculated and compared with the distance between the wells used in the process of driving. W. H. T.

617. A Revolution in Rotary Drilling Machines. H. R. Berry. *Petr. Times*, 1926, 15, 953–954.

As a result of work in Mexico some years ago, a rotary drilling machine was designed which combined the hydraulic feed of the diamond drill with the rotary table and arranged so that the regular rotary practice of feeding from the drum can be used if desired. The weight of the pipe being on the hydraulic cylinder allows of deeper drilling with less twisting hazards. With the new high-speed rotary engine, table speeds of 350 r.p.m. are obtainable. The engine rating is 100 h.p. with a maximum speed of 900 r.p.m. Friction clutches connect the meter to the high and low speed drums and the rotary drive. The hydraulic cylinder is attached to the rotary table frame, the piston having a 24-inch stroke with an upward or downward force of 60 tons.

G. S.

618. The Speed of Drilling in Russia and America. I. Idelson. *The Mining Journal*. Aug., 1925. No. 8, p. 658.

In America, on some areas, the drilling of a well two to three thousand feet deep takes three to four days, while in Russia a similar well, by the Rotary system, would take six to ten months to finish. Many consider the main cause of such a difference to be the actural slowness of drilling itself.

In 1905 one of the richest contract drilling firms did not consider expense

in endeavouring to attain the maximum drilling speed, but even the drilling of this firm lasted immeasurably longer than the American, with drilling rigs and instruments of the most modern type.

The essence of this colossal difference lies in the construction of the borehole. Is there in America an area similar to Bibi-Eibat in which there are 16 oil horizons, in drilling through which to the lower strata it is obligatory to shut off all intervening waters.

In America more than two oil horizons are seldom met with on the one area, and deep wells are to be found with only two columns of casings; these require only one shut off for water, while here for the same depth it would be necessary to make several cementations with a loss of six to eight diameters.

In making a shut off for water, whether by cementation, forcing the casings into unreamed clays, or by pumping liquid clay behind the casings, time must be allowed for the cement to harden and the liquid clays to settle down.

When it was decided to put down shallow wells 400–500 feet deep in Bibi-Eibat bay, to exploit the first and second oil horizons, three to five columns of casings were planned, it being necessary to make two to three water shut offs. The same occurs in the Emba district, where the exploitation depth is between 500–700 feet. Notwithstanding this insignificant depth the drilling lasted four months, the three shut offs occupying not less than two months.

In the absence of accurate geological data for the majority of the Baku areas, the clay for shutting off in must be felt for, *i.e.* to drill not more than two to three feet at a time with a bit of smaller diameter, consequently under-reaming the drilled place. Well No. 47 on the Balalhani area, was drilled 150 sag. to the Kirmakinsky strata by this system, and without exaggeration it can be said that in any well, known to be of a depth of 350–400 sag., such prospect drilling will waste not less than two months' time.

To test the shut off also causes a further delay, and in making three water shut offs these together will cause a loss of time of not less than six to twelve weeks.

Another cause of slow drilling is the abundant experiments with tools of modern inventions, which on the whole greatly affect the average rate of drilling.

T. W.

619. Borehole Deviation in Rotary Drilling. A. Dinnik. *The Mining Journal*. Oct., 1925. No. 10, p. 823.

The author explains the principal cause of declination of boreholes in rotary drilling, without entering into details regarding the direction and degree of declination. It does not lie in the homogeneity of the strata, nor in the intersection of the inclined layers, but in the lateral instability of the long drilling pipe. The drill pipe cannot maintain a straight line of sufficient length, with a great twisting moment, even in fully homogeneous strata. The rods will become crooked and this is followed by the deviation of the bit. It is highly improbable that such a long spindle-like drilling rod of 2000 m. and more in length could remain a straight line.

Knowing the fundamental cause it is possible to point out preventive measures. First of all the twisting moment must be less than the critical. In each individual instance, given the diameter of the rods, the maximum safe depth and the least critical moment must be computed. The twisting moment, communicated to the rods by the engine, must perforce be less than the critical. The factor of safety must be established mainly by practice.

T. W.

620. Swabs for Oil Wells. Henry Alfred Porter. E.P. 259,145 May 27th, 1926.

The swab consists of a stem provided with a head near the upper end and a surrounding sleeve below the head. A nut is attached to the upper end of the sleeve and engages the head when the sleeve is raised. A nut is attached to the lower end of the sleeve and a packer assembly is secured on the sleeve between the two nuts. An overload valve is formed on the stem, and below this a bottom valve which engages the lower end on the sleeve when this is lowered to close the opening. Means are provided for holding the face of the bottom valve in contact with the overload valve unless the swab is overloaded, the overload valve closing a passage through the bottom valve. G. S.

Coal and Shale.

621. Studies of Tar from a Commercial Low-Temperature Retort. H. A. Curtis and H. A. Beekhuis. *Chem. Met. Eng.*, 1926, **33**, 666–9.

The tar examined was produced by the carbonisation of coal by the Carbocoal Process, the coal having the following properties:—moisture, 3·0 per cent.; volatile, 36·0 per cent.; fixed carbon, 50·5 per cent.; ash, 10·5 per cent.; sulphur (ash-free-dry), 1·08 per cent. The tar itself was first distilled to 270° C., when decomposition became apparent. The distillate was then divided into 8 fractions in cuts of 10 to 15 degrees and the tar acids in each fraction isolated. It was found that the specific gravities of the tar-acid fractions plotted against their average boiling points gave a curve which passed through a minimum in the 224°–238° fraction. This suggests that dihydroxy-phenols are present in the higher fractions, an inference which was confirmed by converting the tar-acids into their methyl ethers and plotting specific gravities and equivalent weights against average boiling points. Bakelite products prepared from several of the tar acid fractions gave somewhat inferior materials, but good quality acid-resisting varnishes were obtained. The neutral oils of the crude tar were divided into 23 fractions, but no distinct break in the specific gravity-average distillation temperature-curve was noted. Liquid phase cracking experiments on the neutral oil fractions showed that cracking below 400° C. is very slow, whilst above 450° C. coke formation is rapid and gas yield high. The kerosine fraction is the only part suitable for the production of motor-spirit; its content of spirit boiling below 210° can be increased from the 20 per cent. already present to 35 per cent. H. G. S.

622. Carbonisation of Oil Shale in Rotary Retort. E. Fleischmann. *Brennstoff-Chem.*, 1926, **7**, 229–232.

The working of a Thyssen rotary retort of 80 tons per day capacity is described. The retort was heated by two rows of each 10 double heating shafts, fired with a mixture of shale coke and shale. The material passes through the retort in two hours. The ashes from the shale are employed as material for a cement manufactory. The gases are freed from dust and scrubbed with heavy oil, which extracts the heavier fractions only. The gas is then cooled to 100° C., purified with milk of lime, and debenzenised by means of a Linde refrigerator. The calorific value of the shale was 1,100 cals. and of the shale coke, 500 cals. per kg. From 1 ton of shale 36·90 cb.m. of gas and 30·11 kg. of oil were obtained in practice. Heat balance of the process and analyses of the products are given. H. M.

623. Treatment of Carbonaceous Material. H. Nielsen. U.S.P. 1,605,761.

In order to increase the volume of liquefiable hydrocarbons obtained from carbonaceous materials by distillation or from liquid hydrocarbons by cracking, formic acid is mixed with the material. Formic acid is produced directly from methane or from carbon monoxide and water vapour in the presence of a metallic catalyser. The catalyst is prepared by precipitating copper from a solution of copper sulphate by means of metallic zinc, washed to remove the zinc sulphate, dried, and roasted in the air. At a temperature of 250° to 800° C. methane is oxidised, the resulting products being CO_2H_2O, H, and CHOOH. The formic acid in vapour form is admitted into the still, where it is decomposed, setting free nascent hydrogen. It is claimed that a higher yield of liquid products is thus obtained. R. P.

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(From the official record as printed by the Government Printing Office, Washington.)

"Refinery operations over the past three years are illustrative of the economic tendency I have described.

"*Gasoline was produced more cheaply from cracking than from the initial distillation of the crude*, and in this way by utilizing only distillates 144,000,000 barrels of cracked gasoline were produced.

"To have produced this 144,000,000 barrels of cracked gasoline from the initial distillation of crude, on the basis of the average yield reported by the Bureau of Mines, would have necessitated the running of 585,000,000 barrels of crude.

"*Thus the cracking process during the past three years actually conserved this* 585,000,000 *barrels of crude, which is in excess of the total quantity of crude now in storage in the United States.*"

(*Italics used are ours.*)

Dr. V. Henny,
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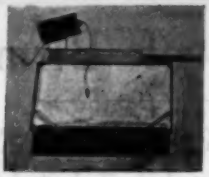

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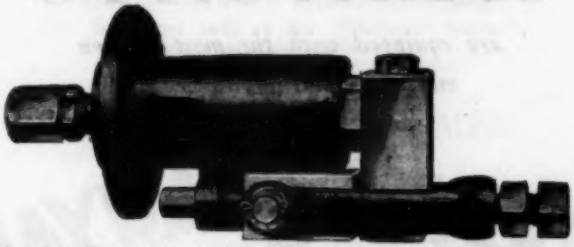

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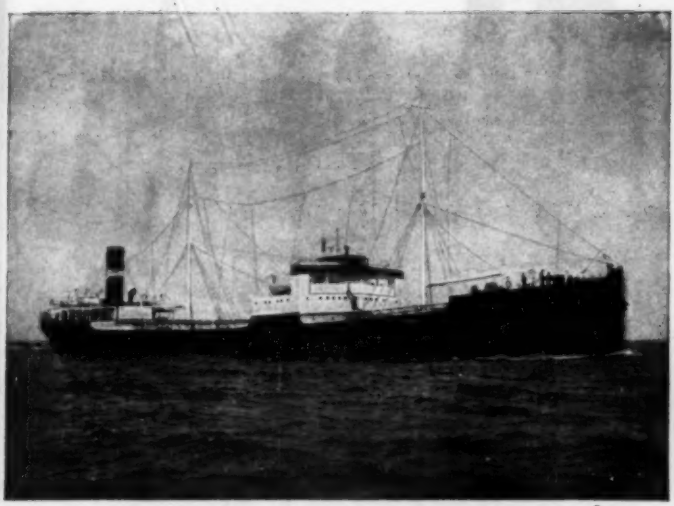

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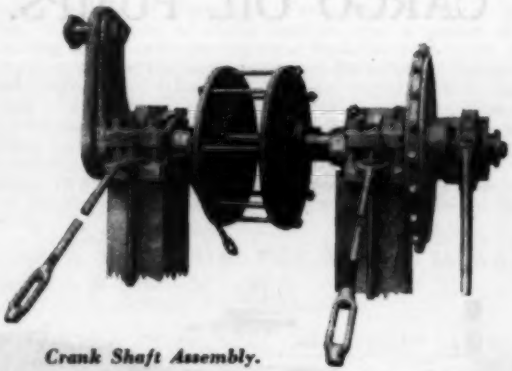

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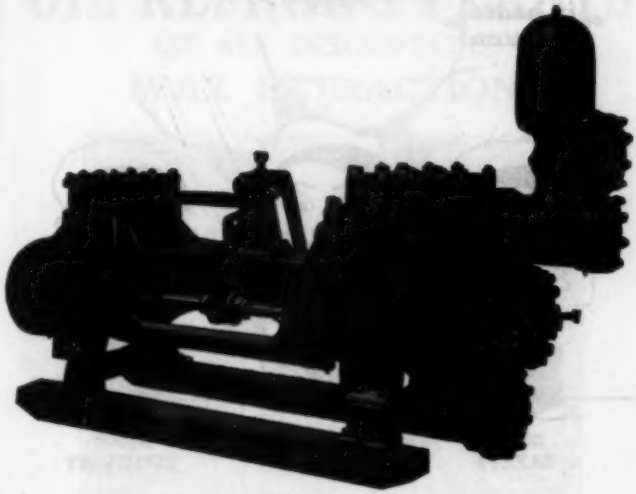

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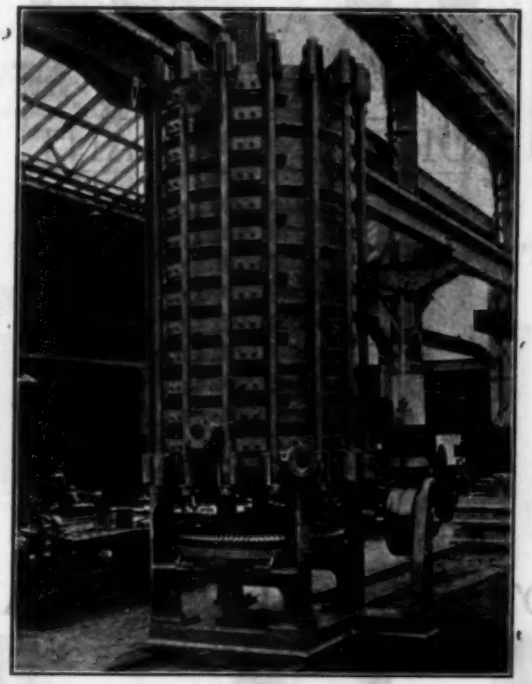

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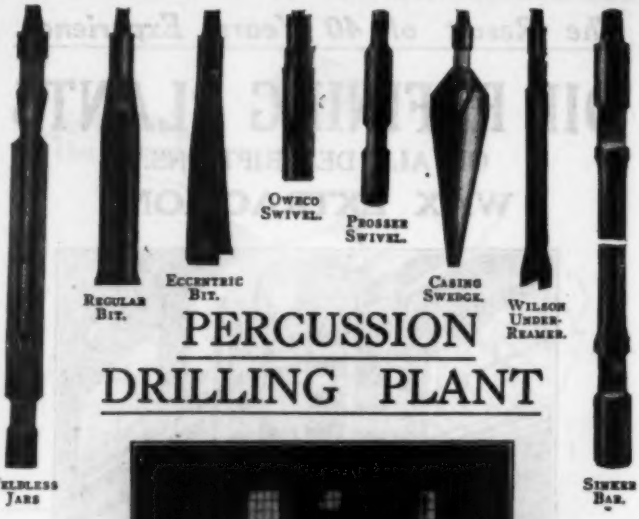

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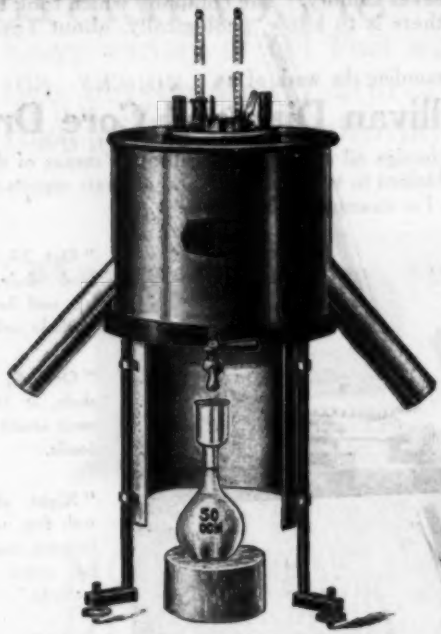

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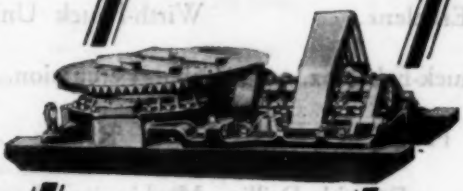

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Electrical Prospecting in Sweden. By K. Sundberg, H. Lundberg and J. Eklund. 1925.

From Sir Thomas H. Holland :—

Indian Geological Terminology. By Sir Thomas H. Holland. Memoirs of the Geological Survey of India. Vol. LI., Part I. 1926.

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From Canada, Department Mines, Mines Branch :—

Final Report of the Peat Committee appointed jointly by the Governments of the Dominion of Canada and the Province of Ontario. Peat, its Manufacture and Uses. By B. F. Haanel.

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From the Ministry of Finance, Geological Survey of Egypt :—

The Geography and Geology of the District between Gebel Ataqua and El-Galala El-Bahariya (Gulf of Suez). By H. Sadek. Paper No. 40, 1926.

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Mineral Resources of the United States, 1922. Part I. Metals.

Petroleum in 1924. By G. B. Richardson and A. B. Coons. II, 29.

Bulletin 768. Geology and Oil Resources of Puente Hills Region, Southern California, U.S.A.

Bulletin 776. Mesozoic Stratigraphy of Alaska. By Geo. C. Martin.

Bulletin 783-B. Mineral Investigations in South-eastern Alaska. By A. F. Buddington.

Bulletin 783-C. Geology and Oil Developments of the Cold Bay District, Alaska.

Bulletin 783-D. The Nixon Fork Country and Silver-Lead Prospects, near Ruby. Papers by John S. Brown.

Bulletin 783-E. Summary of Recent Surveys in Northern Alaska.

Professional Paper 143. Palæontology and Stratigraphy of the Castle Hayne and Trent Marls in North Carolina.

Professional Paper 145. Geology and Oil and Coal Resources of the Oregon Basin, Meeteetse, and Grass Creek Basin Quadrangles, Wyoming.

Water-Supply Paper 558. Preliminary Index to River Surveys made by the U.S. Geological Survey and other agencies.

PERSONAL NOTES OF MEMBERS AND SPECIAL NOTICES.

It is suggested that members send information regarding their movements to the Secretary, for insertion under this heading.

Mr. Arthur Edmund Corbet Cooke, of Digboi P.O., Upper Assam, has changed his name to Cooke Corbet, by Deed Poll, and will in future be described as :—Mr. A. E. Cooke Corbet.

Lieutenant J. H. Blakiston, R.N.R., is on his way back to Venezuela.

Mr. C. W. Breukelman is now in California.

Mr. G. Gordon Thomas is in British Guiana.

Dr. J. A. L. Henderson has left for the West Indies, on professional business, for an absence of about two months.

Mr. F. R. S. Henson has returned from Venezuela.

Major A. D. Lumb is now in England.

Mr. A. C. Mendelsohn is in California.

Mr. J. H. Park is in Persia.

Mr. P. J. Russell has gone to Venezuela.

Mr. C. J. Ward is in Burma.

The Secretary will be glad to receive information as to the whereabouts of the following members :—G. R. Clark, Lieutenant C. N. Colson, R.N., J. A. Greene, M. E. A. Iaroslavici, C. E. Jobling, A. Mayfield, Engr.-Comdr. W. T. Parez, R.N., R. J. Stallard, S. Stock, and B. G. Yovanovitch.

DECENNIAL INDEX, 1914-24.

The Index to Volumes I. to X. of the Journal of the Institution of Petroleum Technologists, 1914 to 1924, is now completed. This index contains some 10,000 references to subjects and localities mentioned in the Journals. The publishing price is 7s. 6d., but members of the Institution are entitled to receive copies at 4s. per copy.

"THE PETROLEUM INDUSTRY."

In order to dispose of the few remaining copies of "The Petroleum Industry," which contains the lectures delivered at the Oil Exhibition, Crystal Palace, 1920, it has been decided to offer these at 2s. 6d. per copy.

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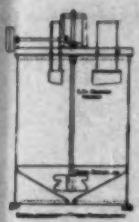

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